

SEMI-ANNUAL STATUS REPORT

Effect of Chronic Restraint on Absorption from the
Gastrointestinal Tract

NASA Research Grant NGR-14-008-003

Submitted By:

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SEMI-ANNUAL STATUS REPORT

Studies aimed at elucidating possible changes in gastrointestinal absorption between chronically restrained animals and unrestrained animals are continuing to be investigated under NASA grant NGR-14-008-003. Presently studies concerning the absorption of glucose have been completed and the results are presented below and in the accompanying graphs. Additional studies on glucose absorption via in vitro techniques are being carried out as well as studies on amino acid and lipid absorption. The following results are those obtained as the result of our first full year of investigation:

Hematological Values

Leucocyte counts of blood from animals restrained one week ranged from 6,270 to 12,650 with an average value of 9,800; for the same week the counts in unrestrained animals ranged from 9,130 to 12,400 with an average value of 10,970. At the end of the twenty-fifth week of restraint, leucocyte counts in the same animals ranged from 15,070 to 20,350 with an average of 17,400 for the restrained rats and a range of 13,310 to 35,580 with an average of 21,646 for the control (unrestrained) rats.

The hematocrit packed-cell-volume (PCV) (chart 1) for the first nine weeks stayed about the same with minor fluctuations. From week ten until the end of week twenty-five the PCV remained consistently but only slightly lower in the restrained than the control animals ranging from 0.6

to 3.8% lower with an average of 2.1%. Actual PCV averages of 10 animals varied from 53.5 to 50.0 for restrained animals with an average of 51.8 and from 55.4 to 52.4 with an average of 53.9 for the unrestrained animals over this period.

Effects of Restraint on Body Weight

The effect of restraint on body weight is shown in graph A. At the end of 25 weeks those animals restrained showed an increase of 58.2% over their initial weights while the unrestrained animals increased in weight by 83.5%.

The peaks of each of the curves as well as the plasma glucose levels were also plotted (graphs C-1 - C-2) and again no significant differences were noted from week seven to week twenty-five.

Another method, the results of which are not completed, which is being used to study the effects of restraint on G-I absorption is to kill the animal at a certain time after test meal administration, remove the G-I tract and wash out its contents with warm saline. The contents are then diluted to a known volume, filtered, precipitated, and analyzed. In the case of glucose at the end of twenty-five weeks the restrained animals at the end of 45 minutes had an average total recovery of 43.3mg. where as the unrestrained animals an average total of 44.0mg. was recovered, (chart 2). This further illustrates the fact that at the end of 25 weeks of restraint there is no statistically significant difference in glucose absorption.

It should be noted that between the third and fourth week the unrestrained animals showed a definite decrease in weight. The graph represents the average of only 10 animals in each group but additional groups of 60 animals each, also show this tendency between the third and fourth week after being isolated, (one animal to a cage); the unrestrained animals gained little or no weight or lost weight. This was noted regardless of the weight of the animals when isolation was initiated.

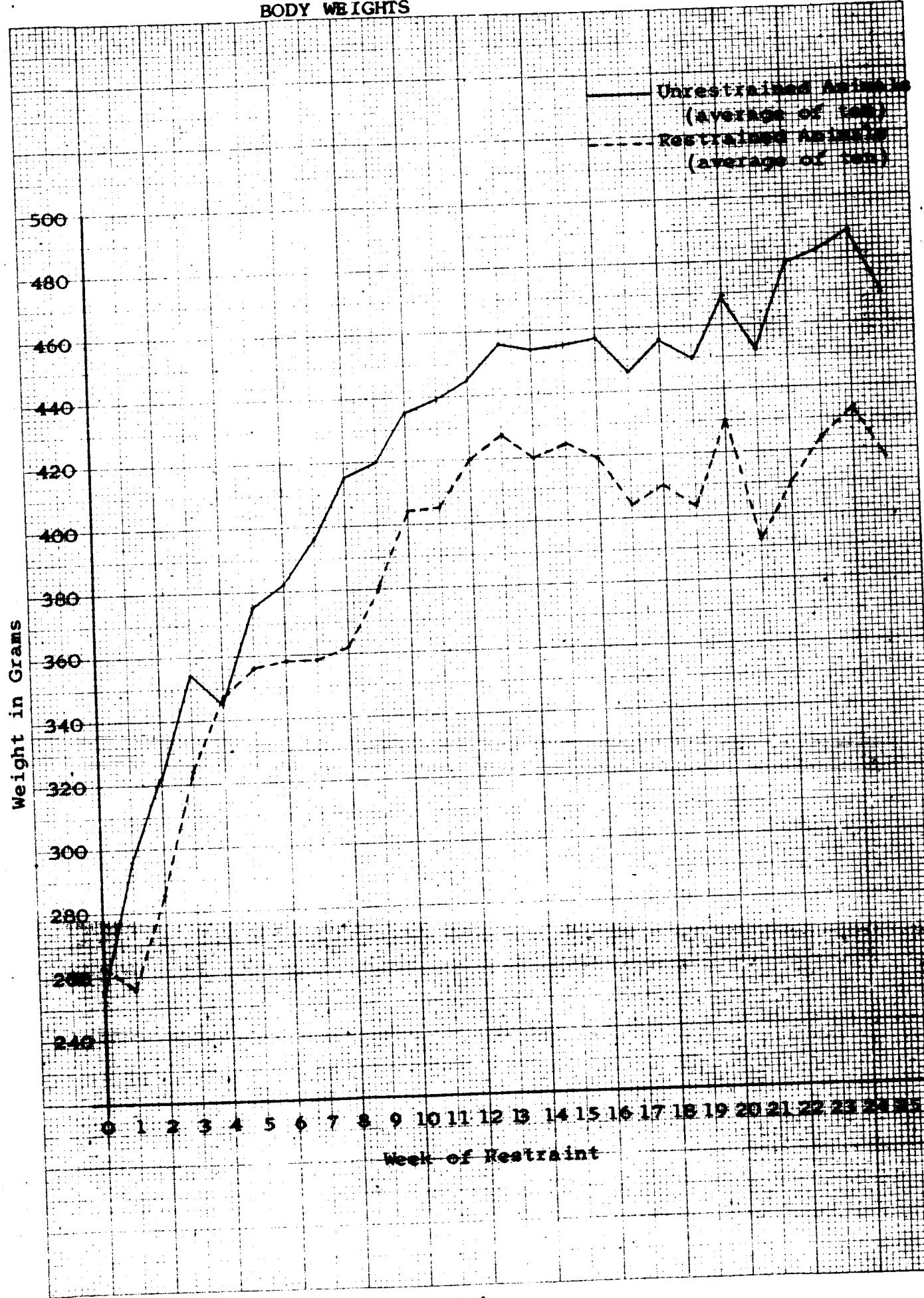
Glucose Absorption in Restrained and Non-Restrained Rats

The absorption of glucose in restrained and unrestrained rats was investigated by the administration of 415^{+5} mg. glucose in 1 ml. aqueous solution. The administration was followed by serial blood sampling and determination of plasma glucose levels by the enzymatic glucose oxidase method (glucostat, Worthington Biochemical).

Absorption curves constructed from data thus obtained are presented for weeks 1-25 for both restrained and non-restrained animals, (see graphs B-1 to B-25). At the end of the first and second week of restraint the absorption of glucose by the restrained animals excessively rapid, weeks three and four show that this excessive absorption begins a downward trend with decreased absorption which continues down until week seven. From the end of week seven where the absorption begins proceeding at about the same rate, to the end of the test period of 25 weeks, absorption curves between the two groups of rats vary insignificantly. Though generally lower over the last 18 weeks of restraint, variations do occur but in no case do the differences between the curves exceed the 95% level of confidence.

BODY WEIGHTS

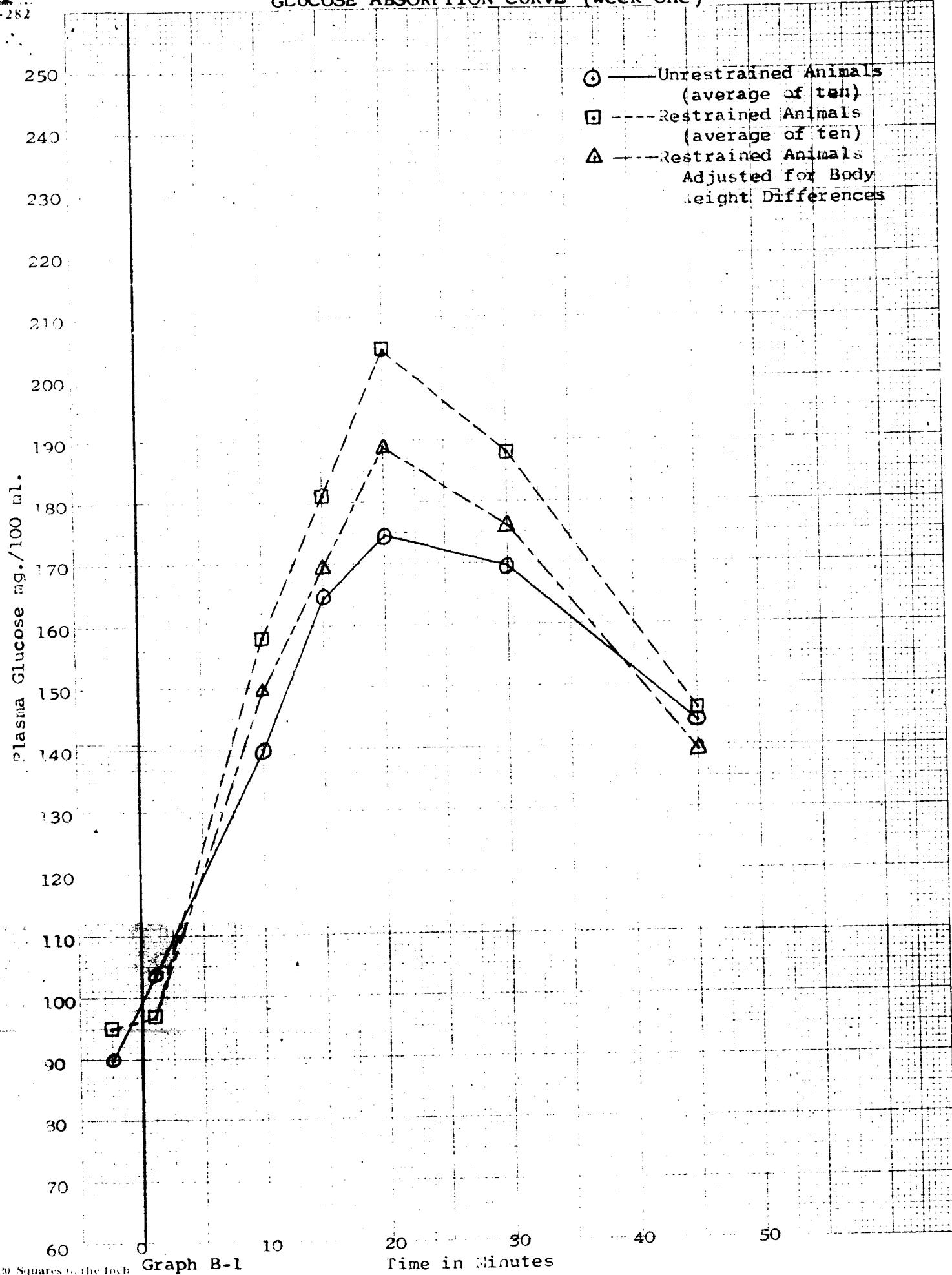
12-282



Graph A

GLUCOSE ABSORPTION CURVE (Week One)

12-282



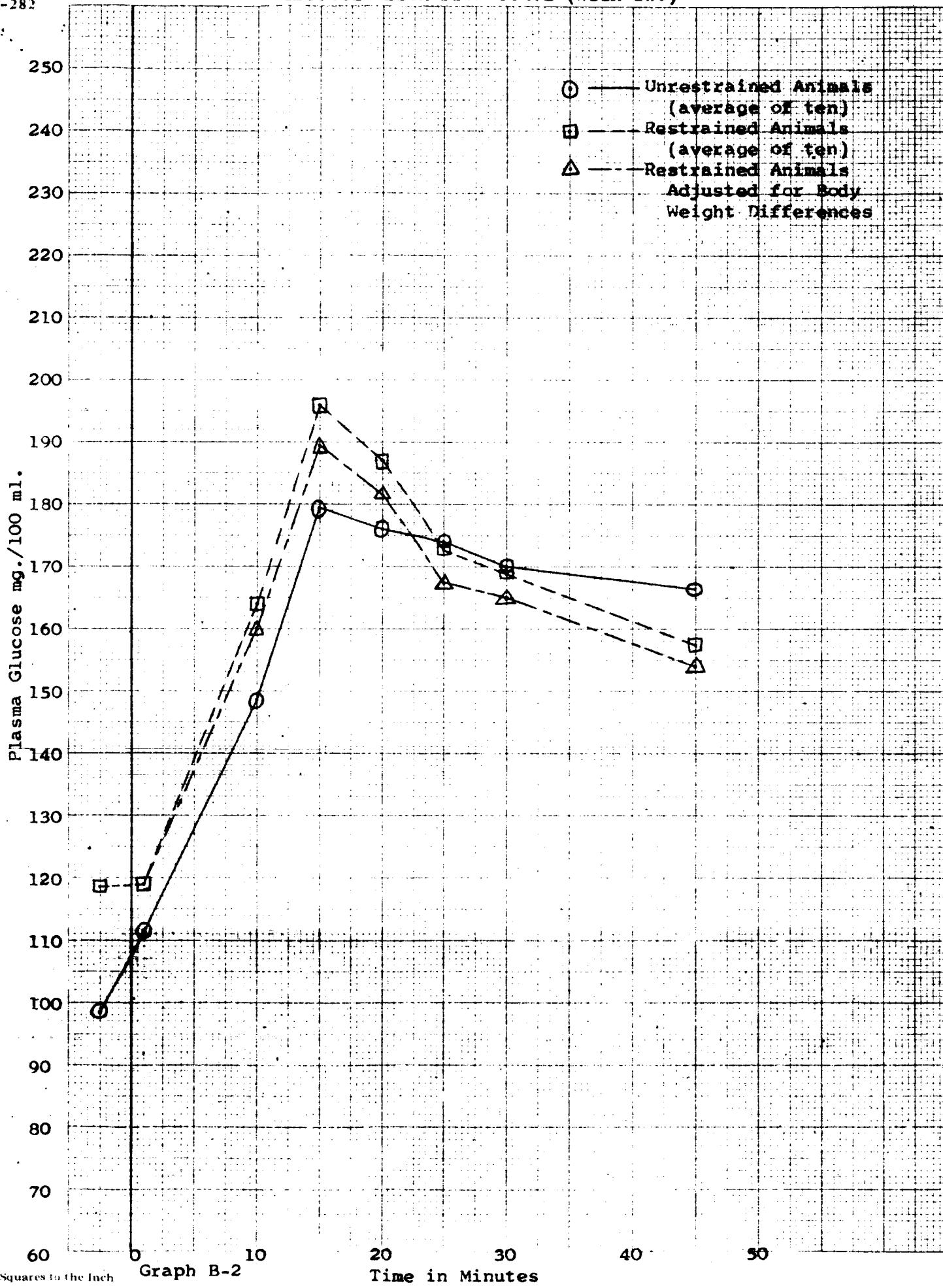
.10 Squares to the Inch

Graph B-1

Time in Minutes

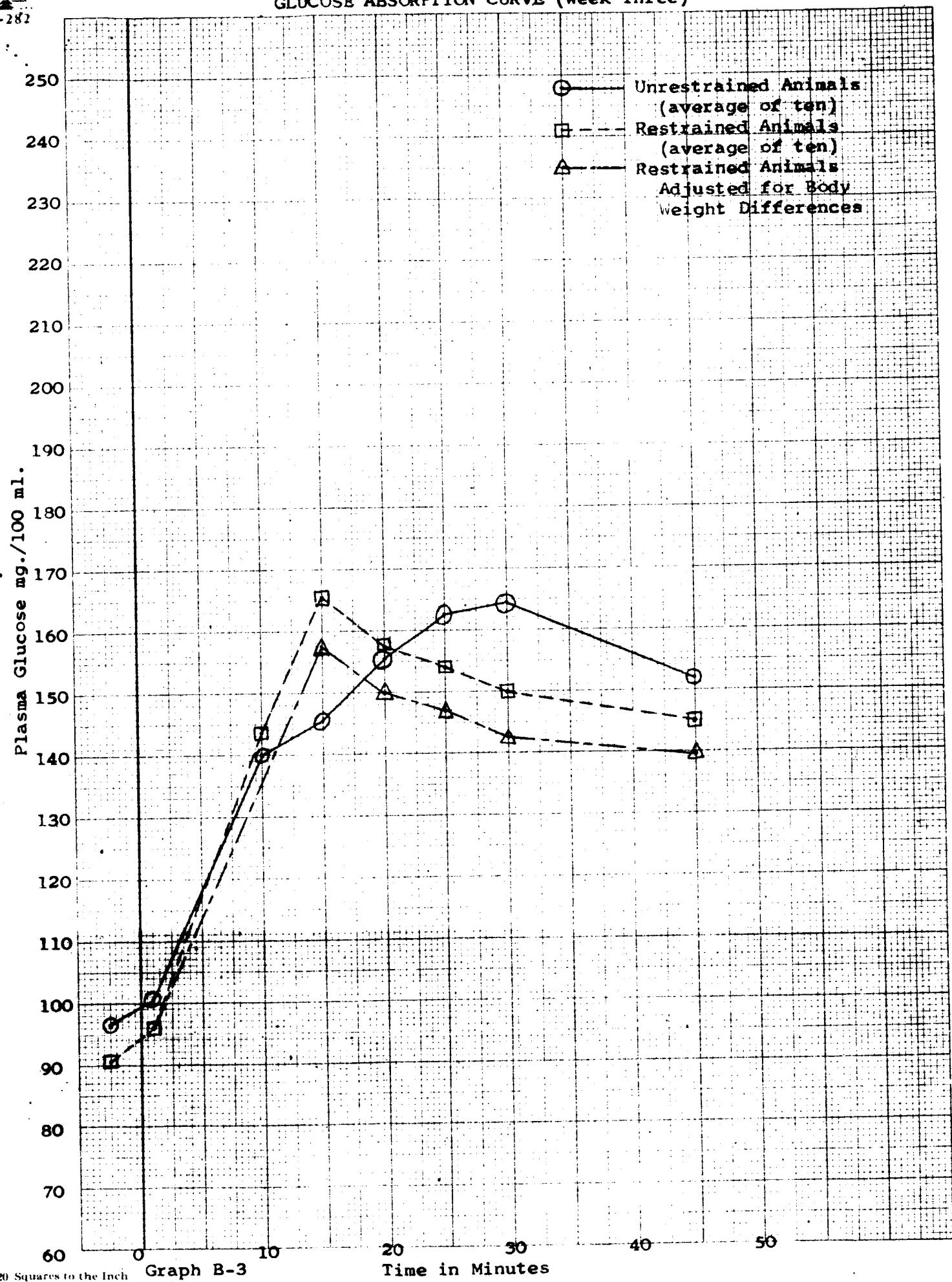
12-282

GLUCOSE ABSORPTION CURVE (Week Two)



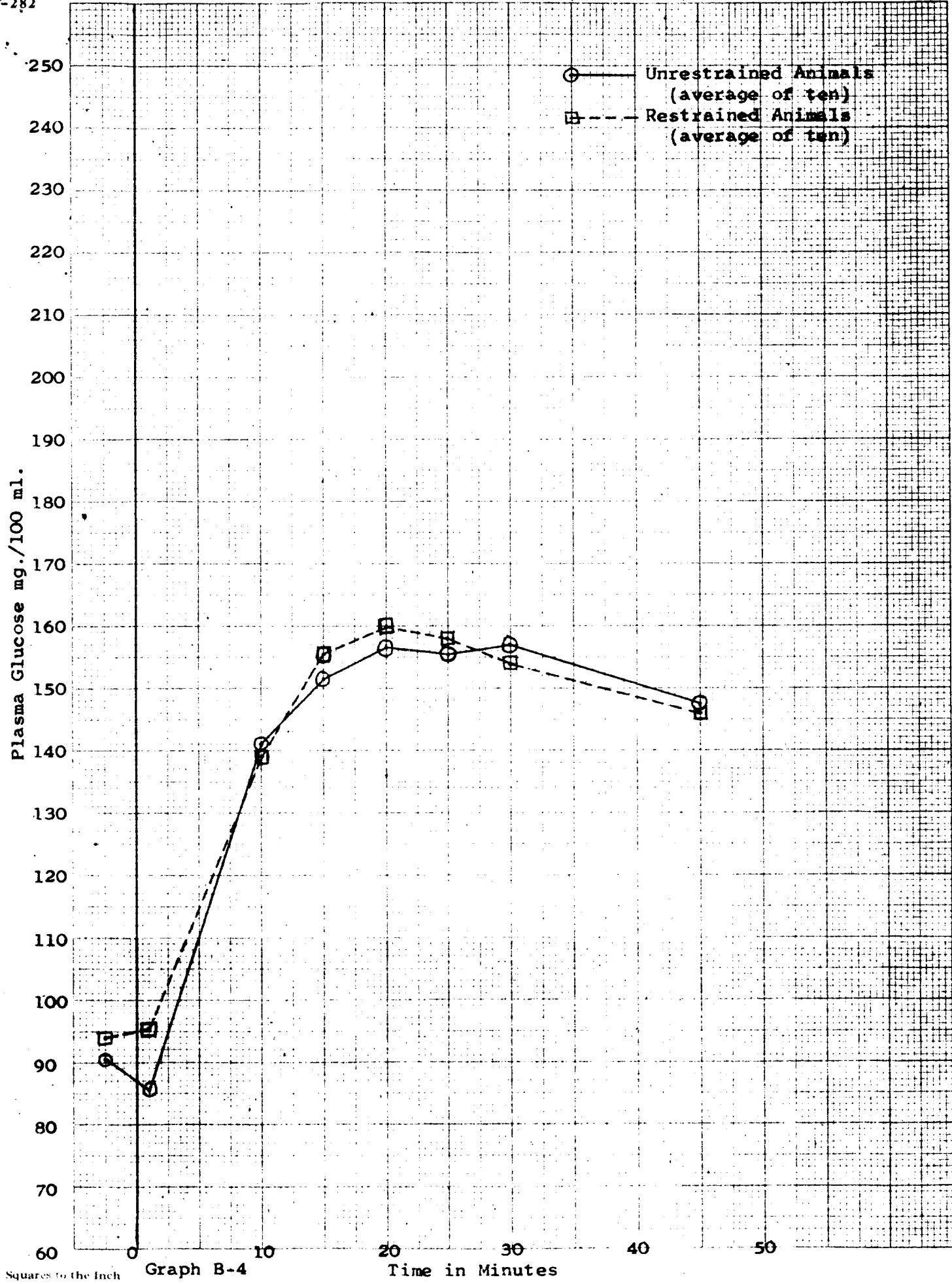
GLUCOSE ABSORPTION CURVE (Week Three)

12-282



GLUCOSE ABSORPTION CURVE (Week Four)

2-282

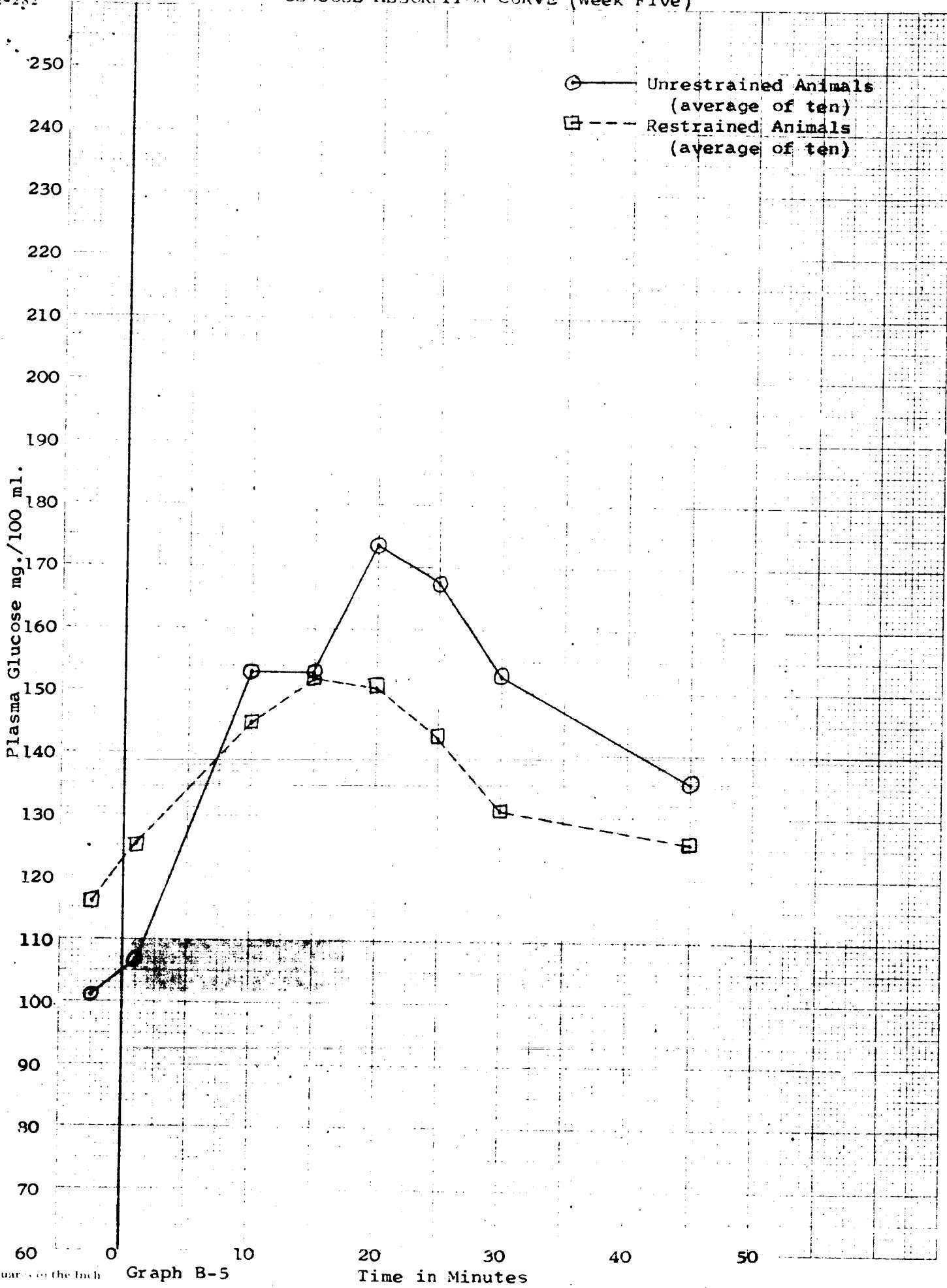


20 Squares to the Inch

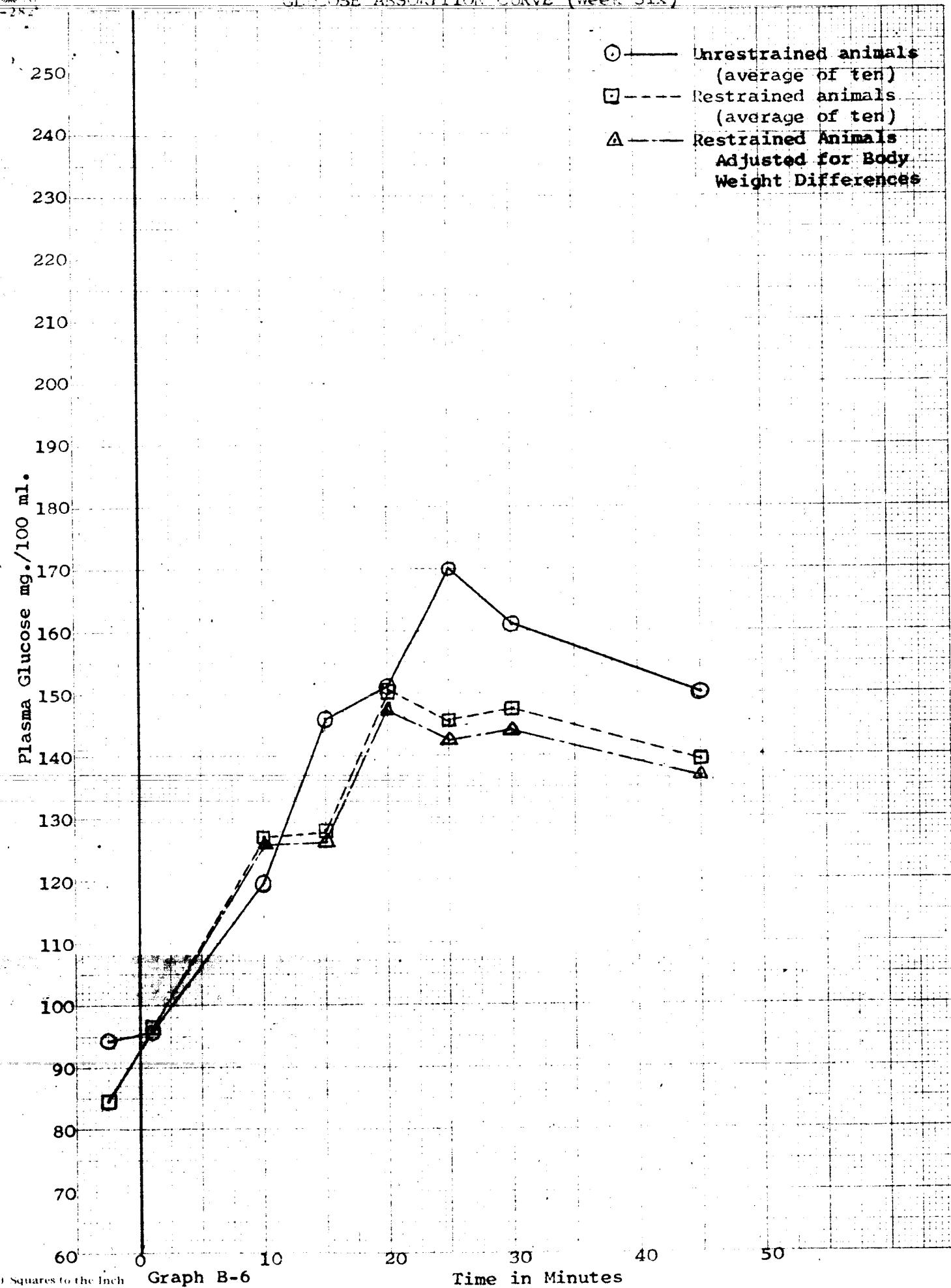
Graph B-4

Time in Minutes

GLUCOSE ABSORPTION CURVE (Week Five)



GLUCOSE ABSORPTION CURVE (week Six)



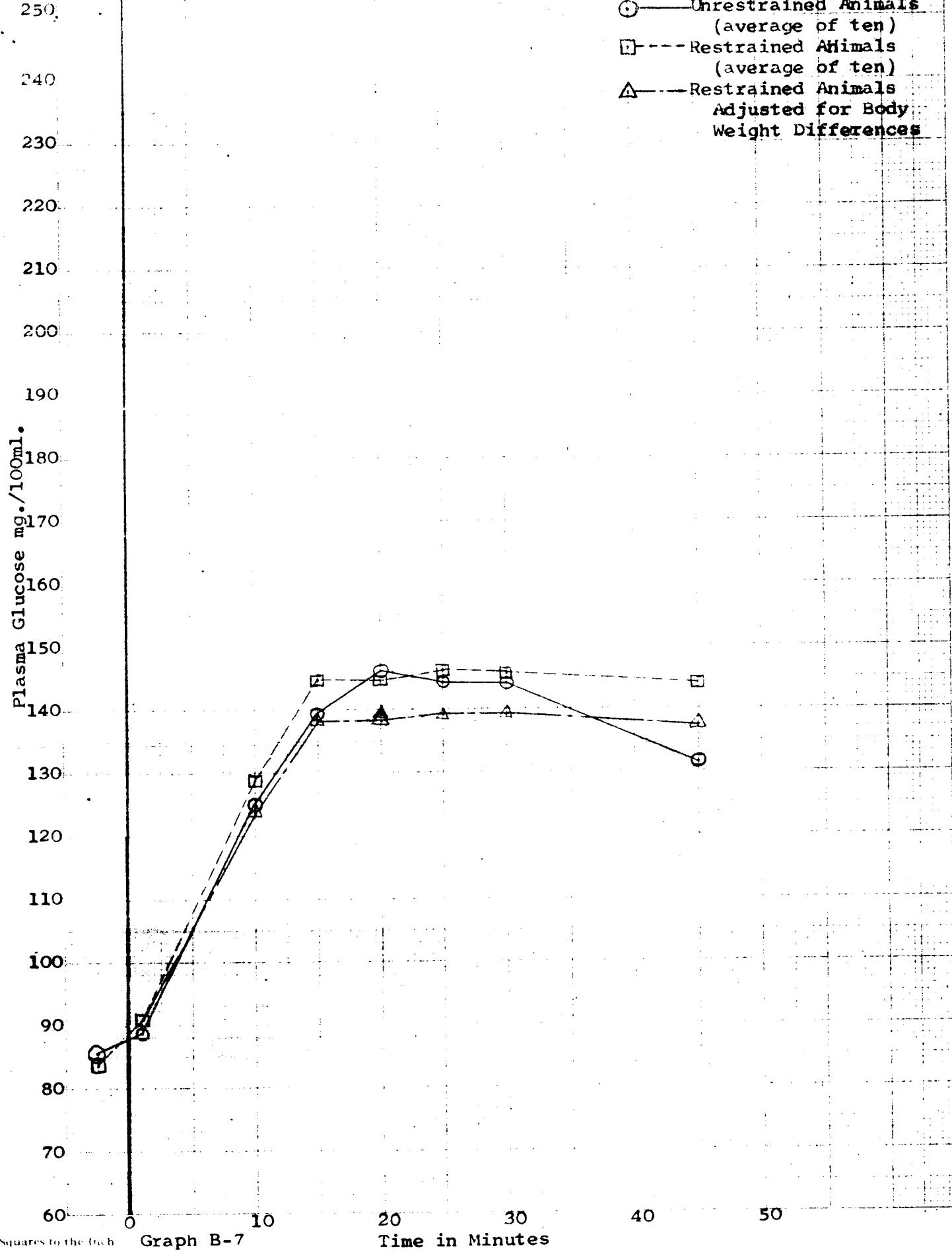
20 Squares to the Inch

Graph B-6

Time in Minutes

GLUCOSE ABSORPTION CURVE (week Seven)

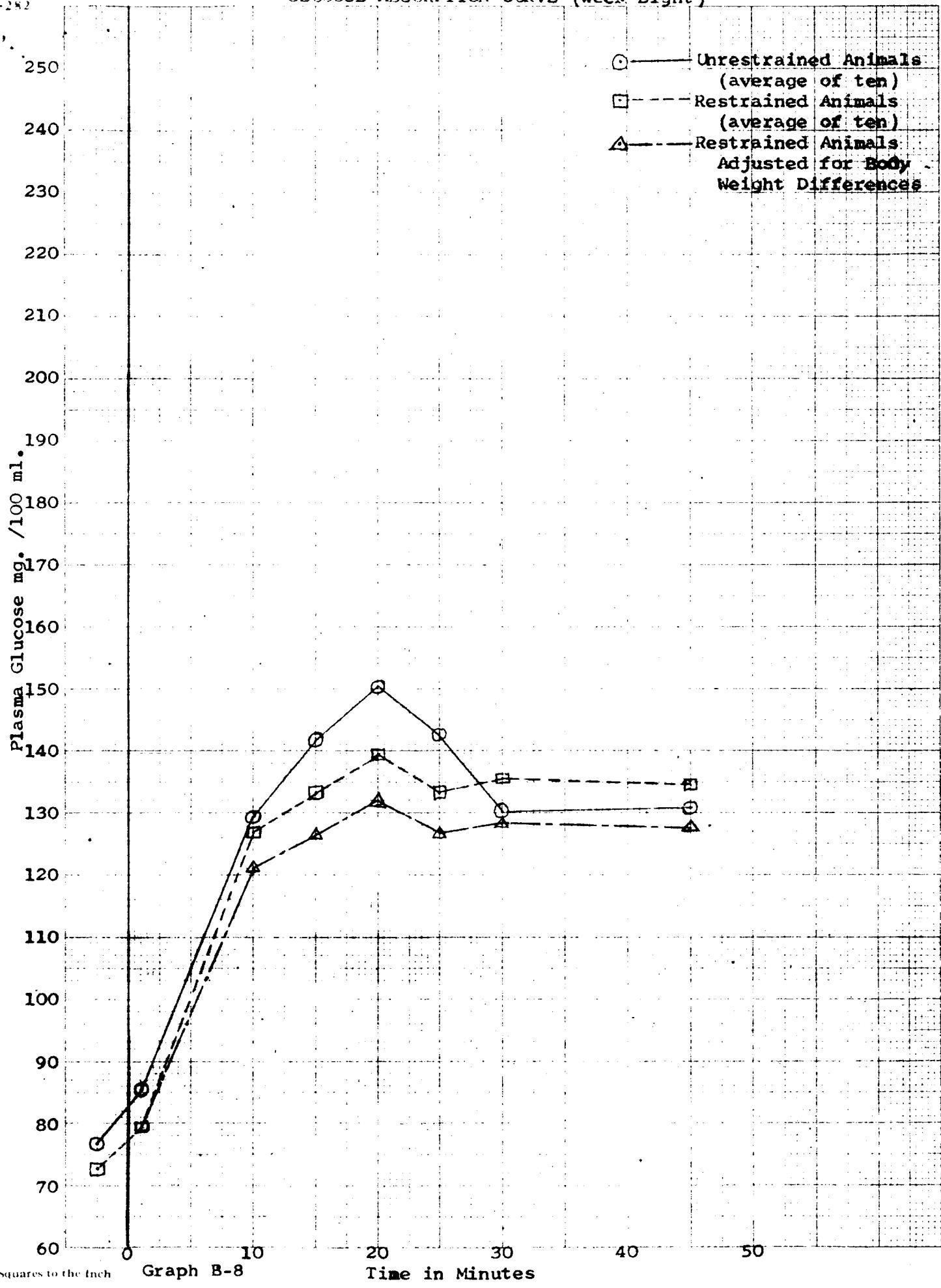
12-282



20 Squares to the Inch

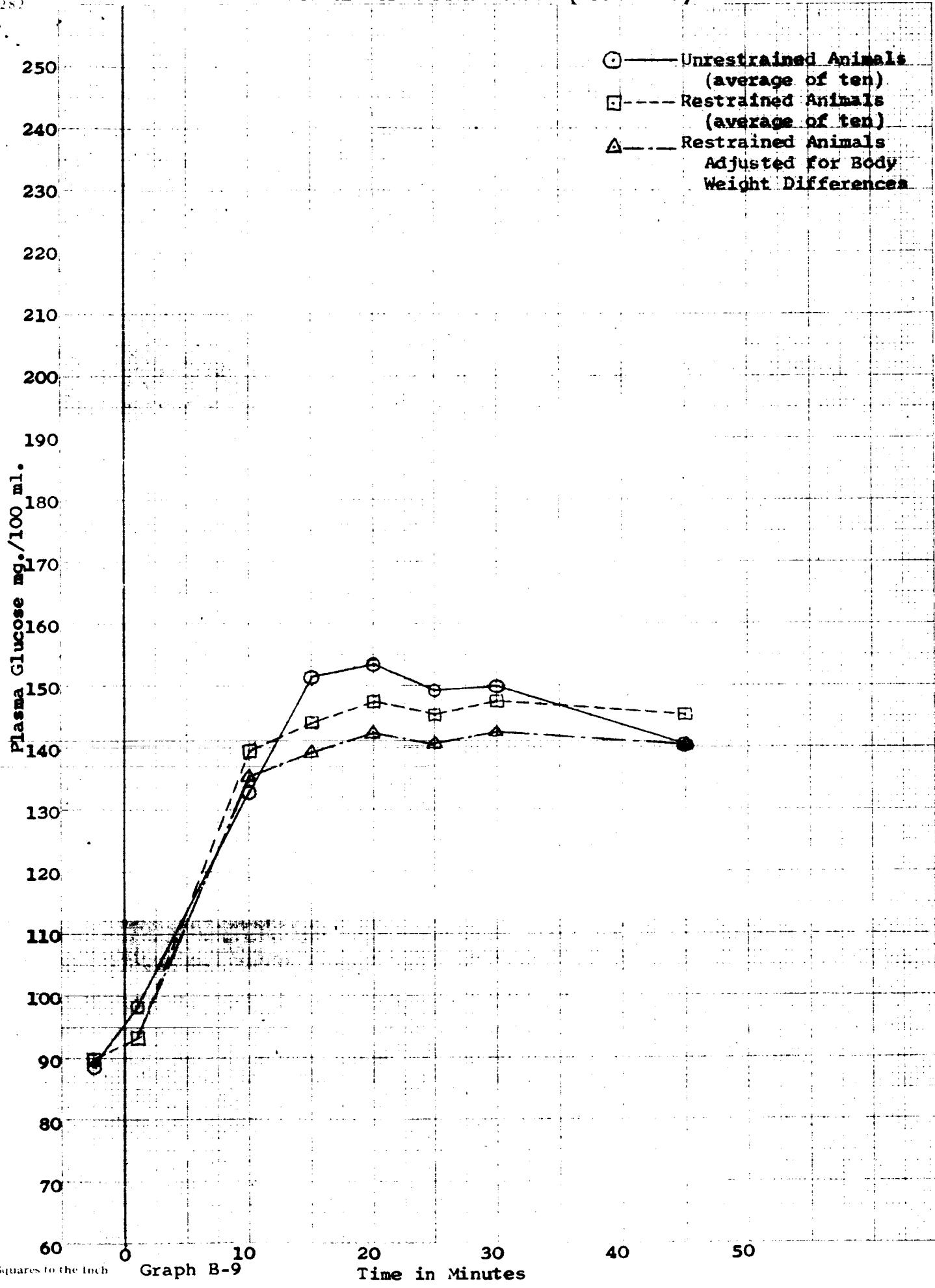
Graph B-7

GLUCOSE ABSORPTION CURVE (Week Eight)



12-282

GLUCOSE ABSORPTION CURVE (Week Nine)



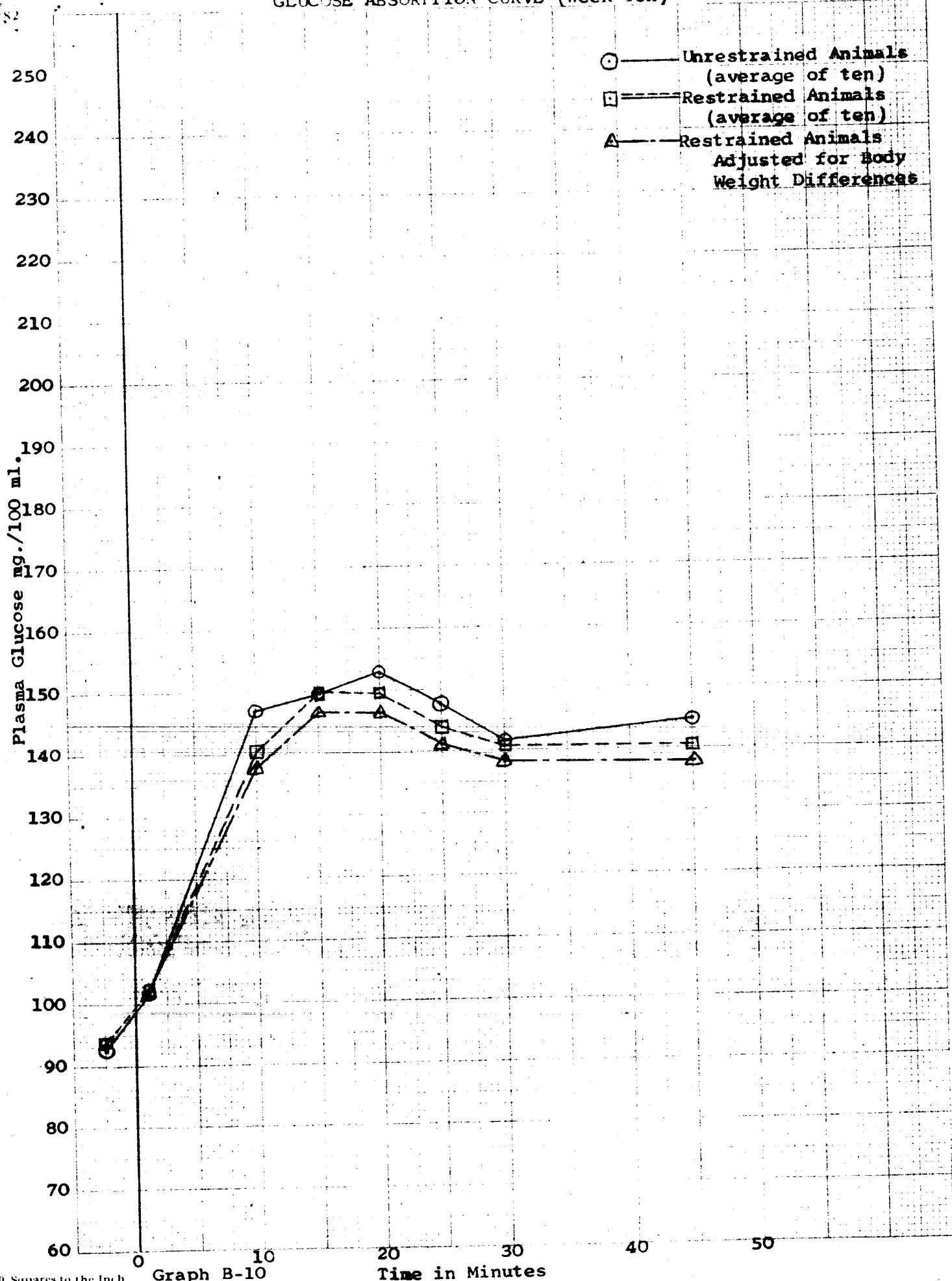
20 Squares to the Inch

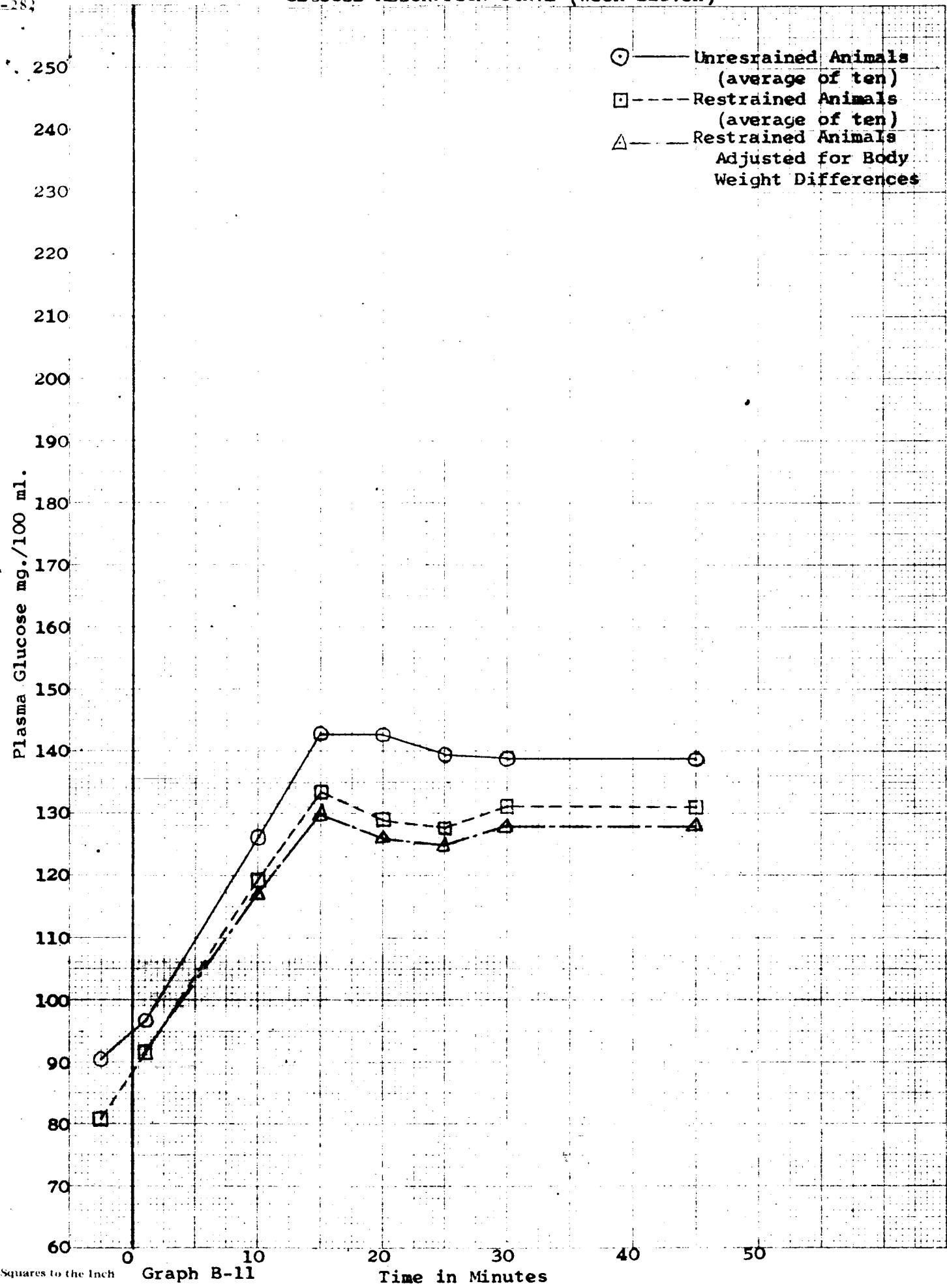
Graph B-9

Time in Minutes

12-582

GLUCOSE ABSORPTION CURVE (week Ten)



P
12-284
GLUCOSE ABSORPTION CURVE (Week Eleven)

20 Squares to the Inch

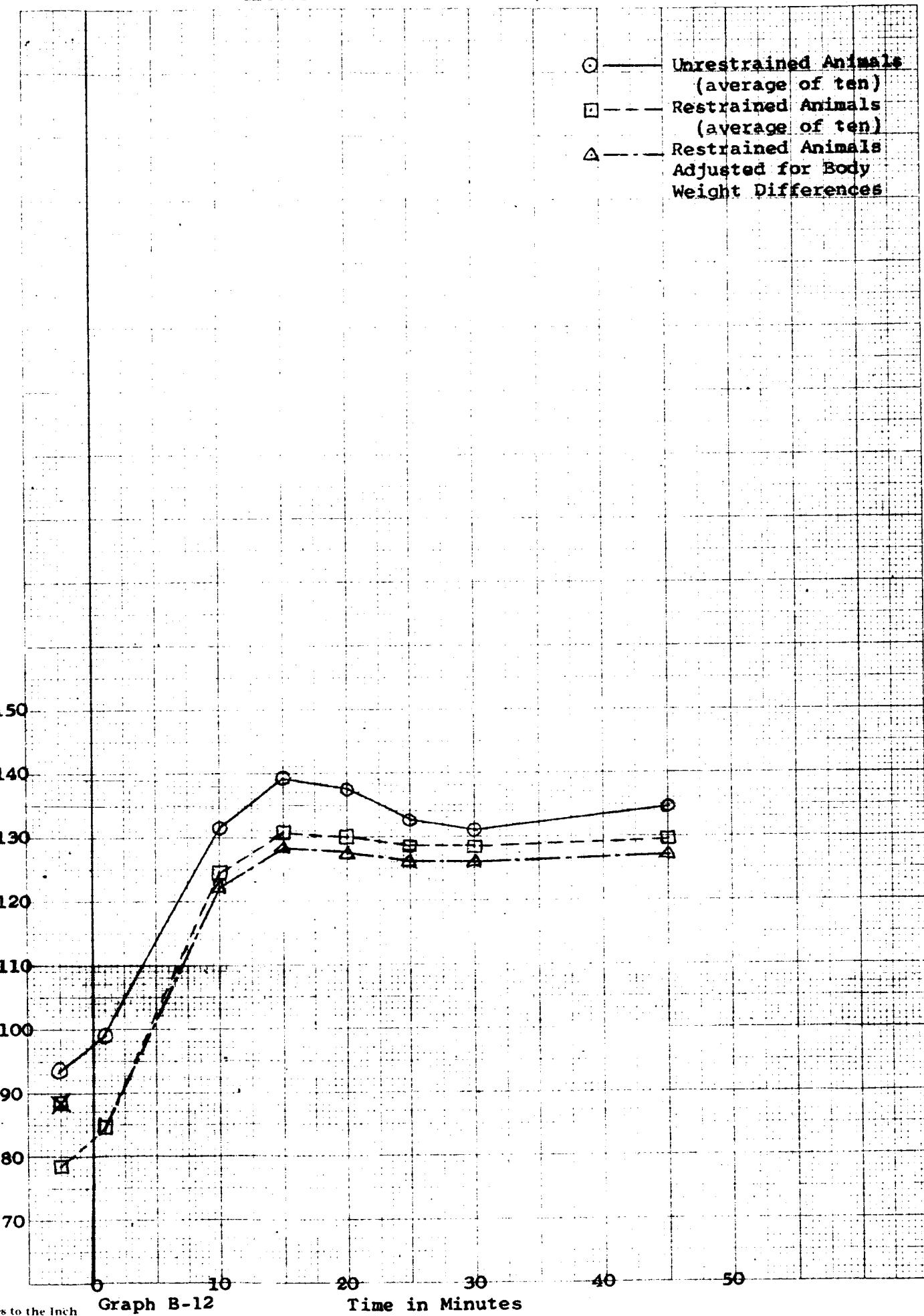
Graph B-11

Time in Minutes

GLUCOSE ABSORPTION CURVE (Week Twelve)

12-282

Plasma Glucose mg. /100 ml.



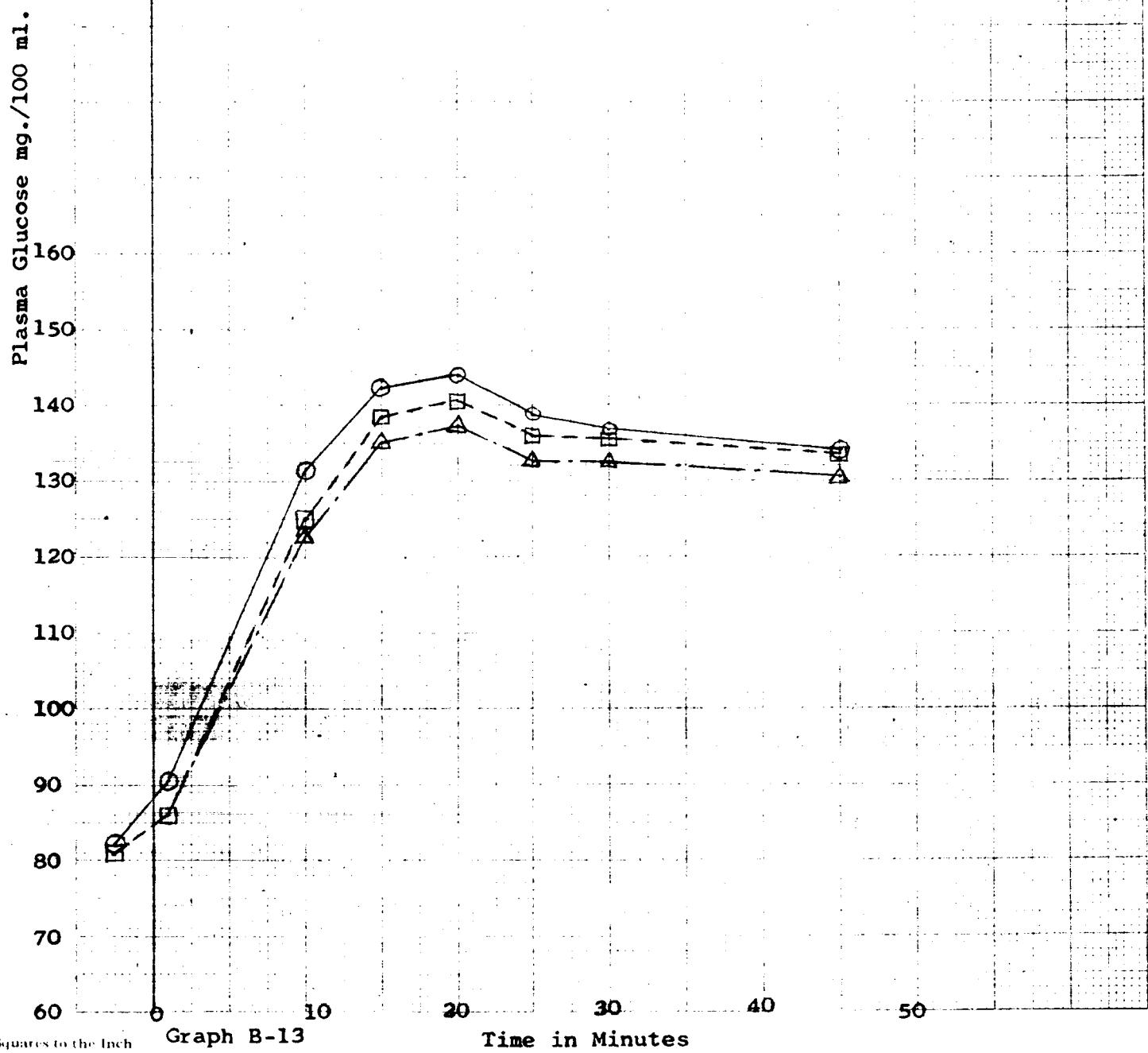
20 Squares to the Inch

Graph B-12

Time in Minutes

GLUCOSE ABSORPTION CURVE (Week Thirteen)

○—Unrestrained Animals
(average of ten)
□---Restrained Animals
(average of ten)
△---Restrained Animals
Adjusted for Body
Weight Differences



GLUCOSE ABSORPTION CURVE (Week Fourteen)

12-282

- Unrestrained Animals
(average of ten)
- Restrained Animals
(average of ten)
- △--- Restrained Animals
Adjusted for Body
Weight Differences

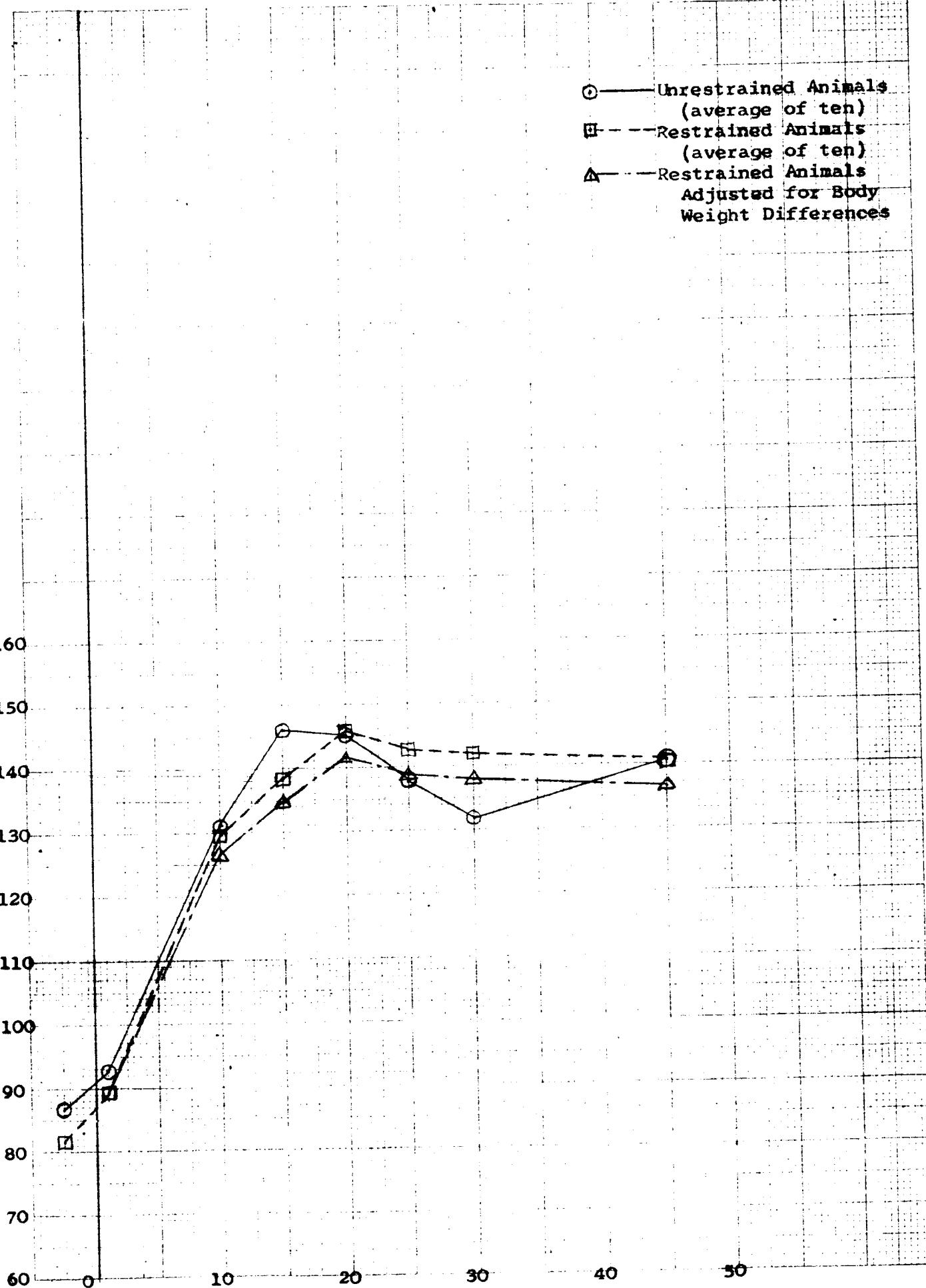
Plasma Glucose mg./100 ml.

160
150
140
130
120
110
100
90
80
70

20 Squares to the Inch

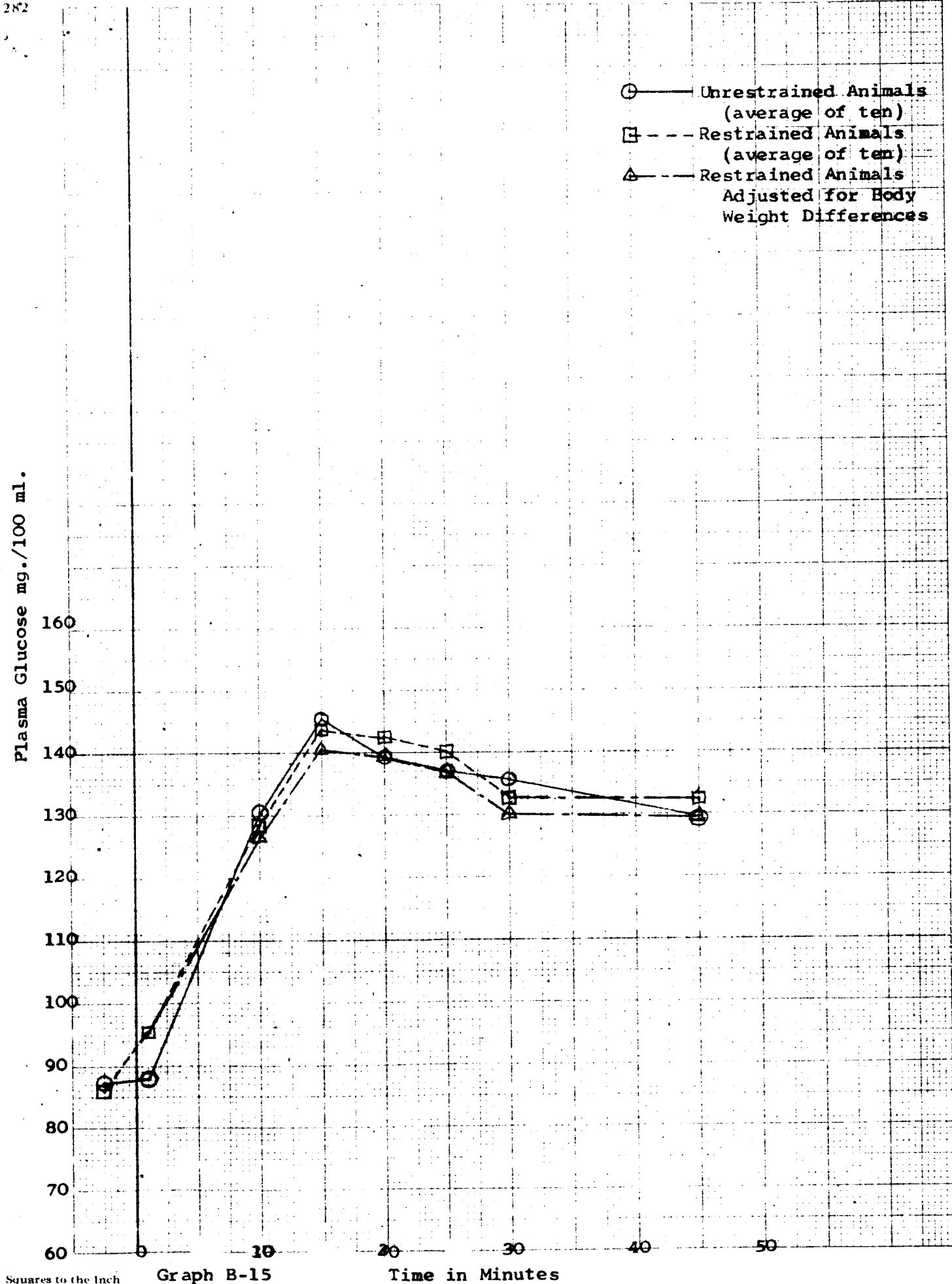
Graph B-14

Time in Minutes

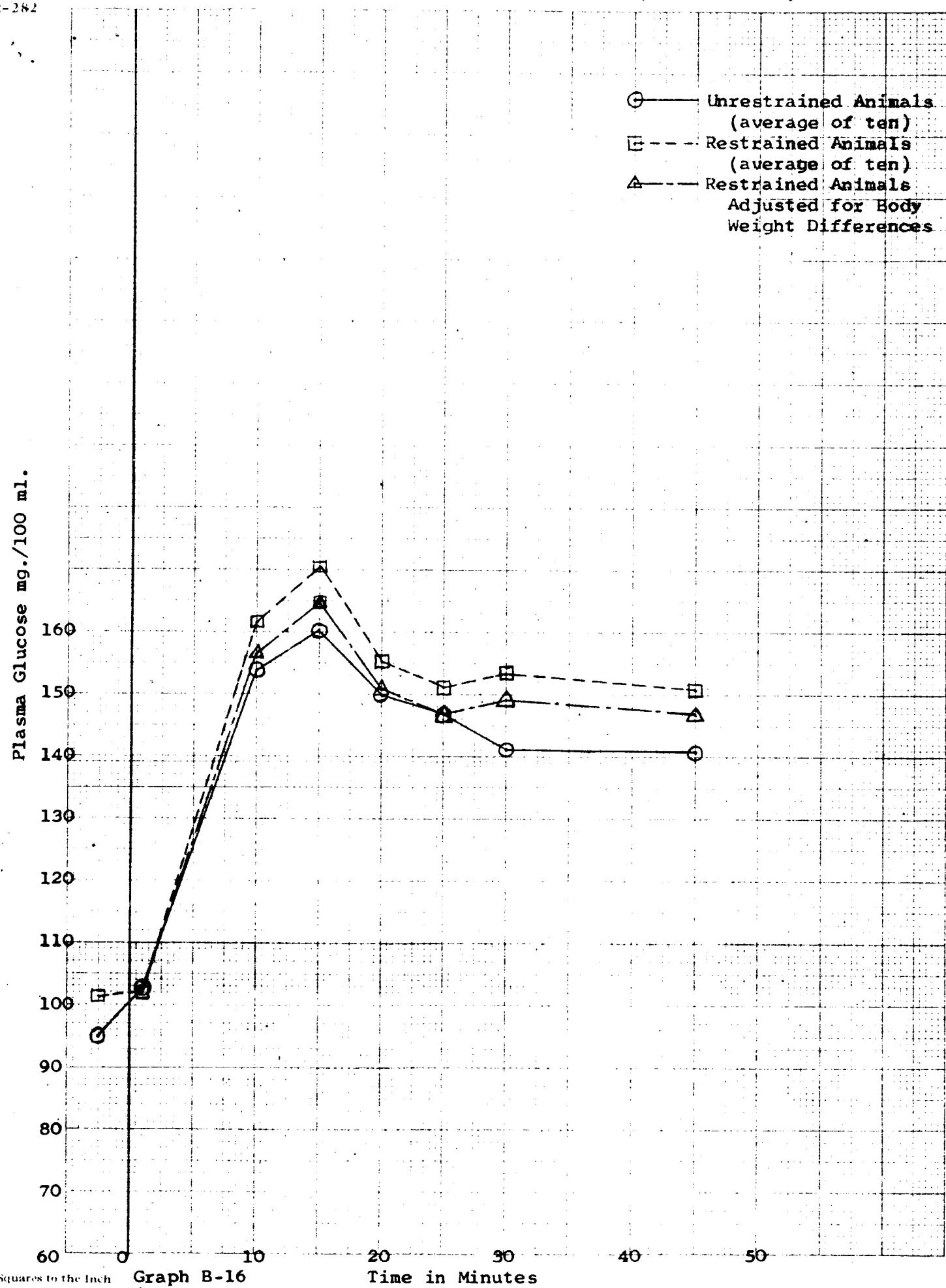


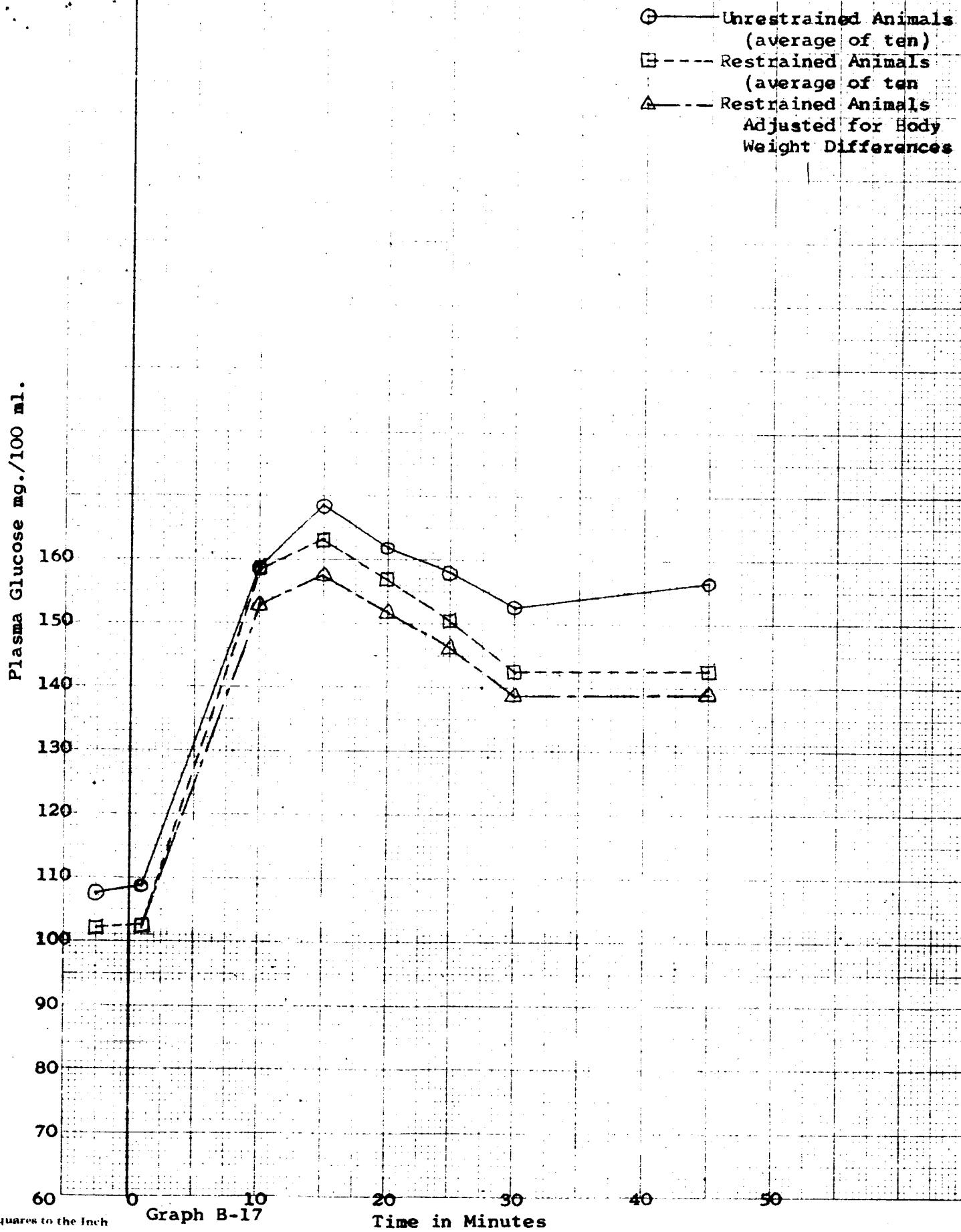
GLUCOSE ABSORPTION CURVE (Week Fifteen)

12-282



GLUCOSE ABSORPTION CURVE (Week Sixteen)



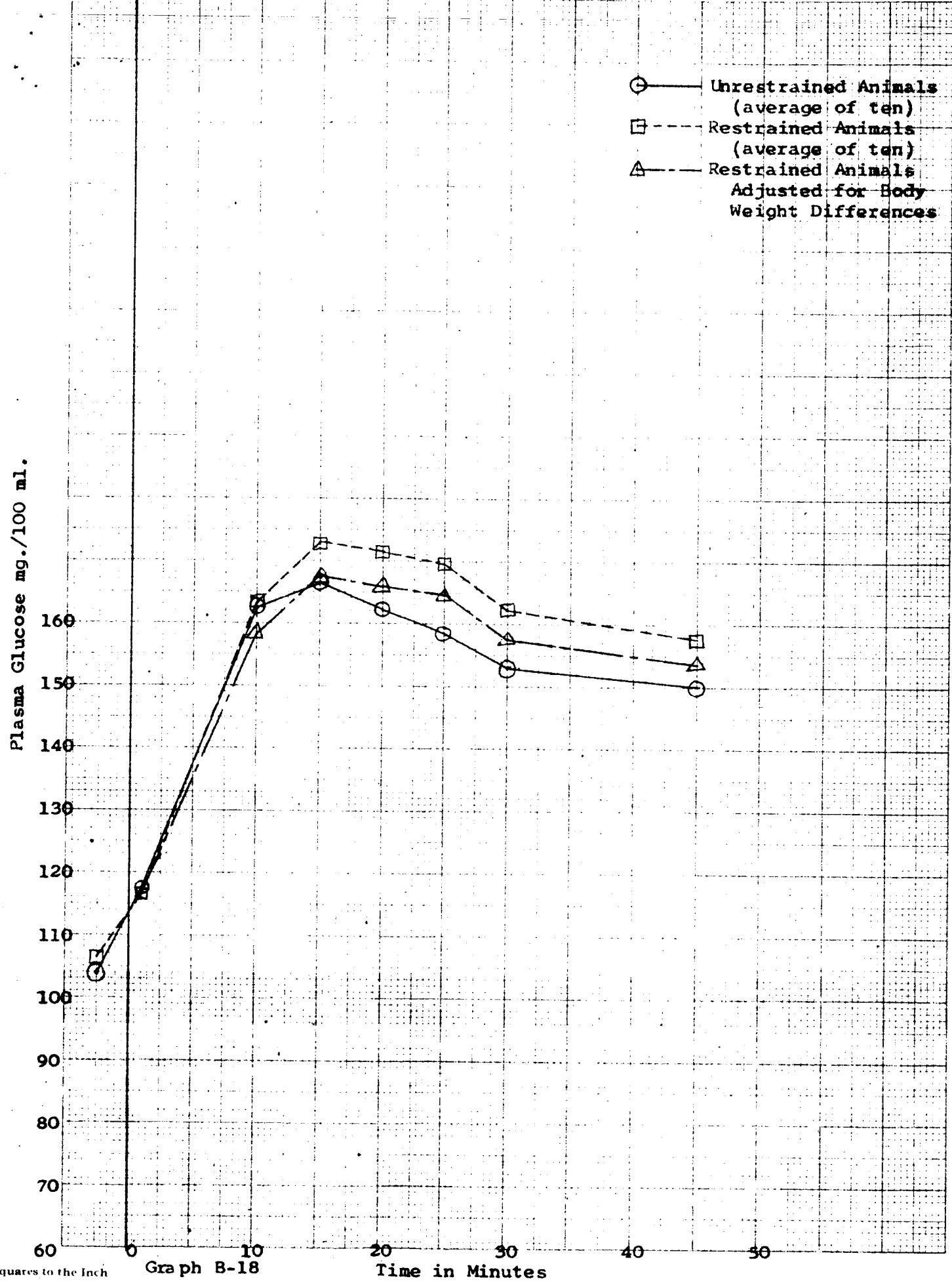


20 Squares to the Inch

Graph B-17

Time in Minutes

GLUCOSE ABSORPTION CURVE (Week Eighteen)



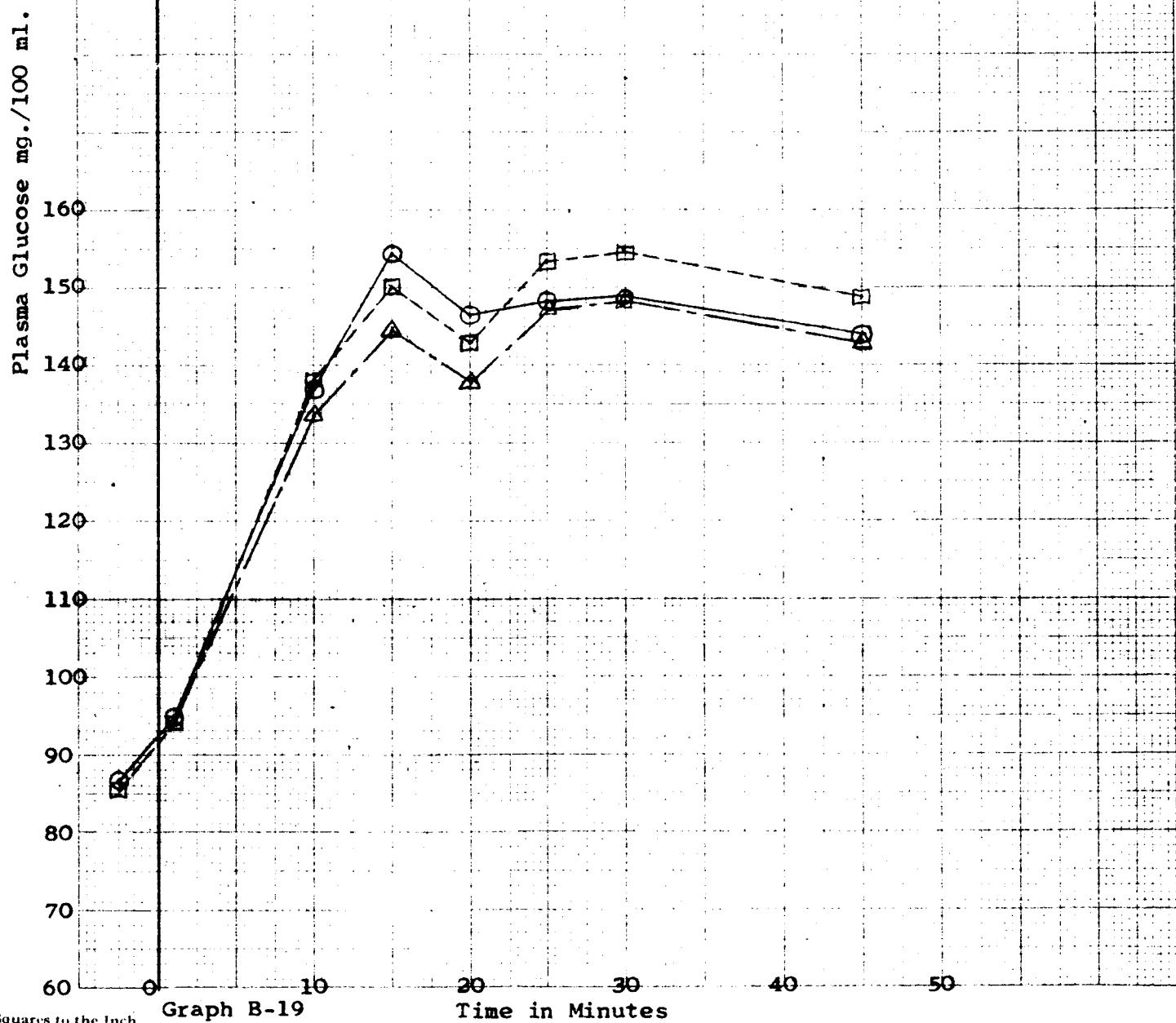
20 Squares to the Inch

Graph B-18

Time in Minutes

GLUCOSE ABSORPTION CURVE (Week Nineteen)

- Unrestrained Animals
(average of ten)
- Restrained Animals
(average of ten)
- △--- Restrained Animals
Adjusted for Body
Weight Differences



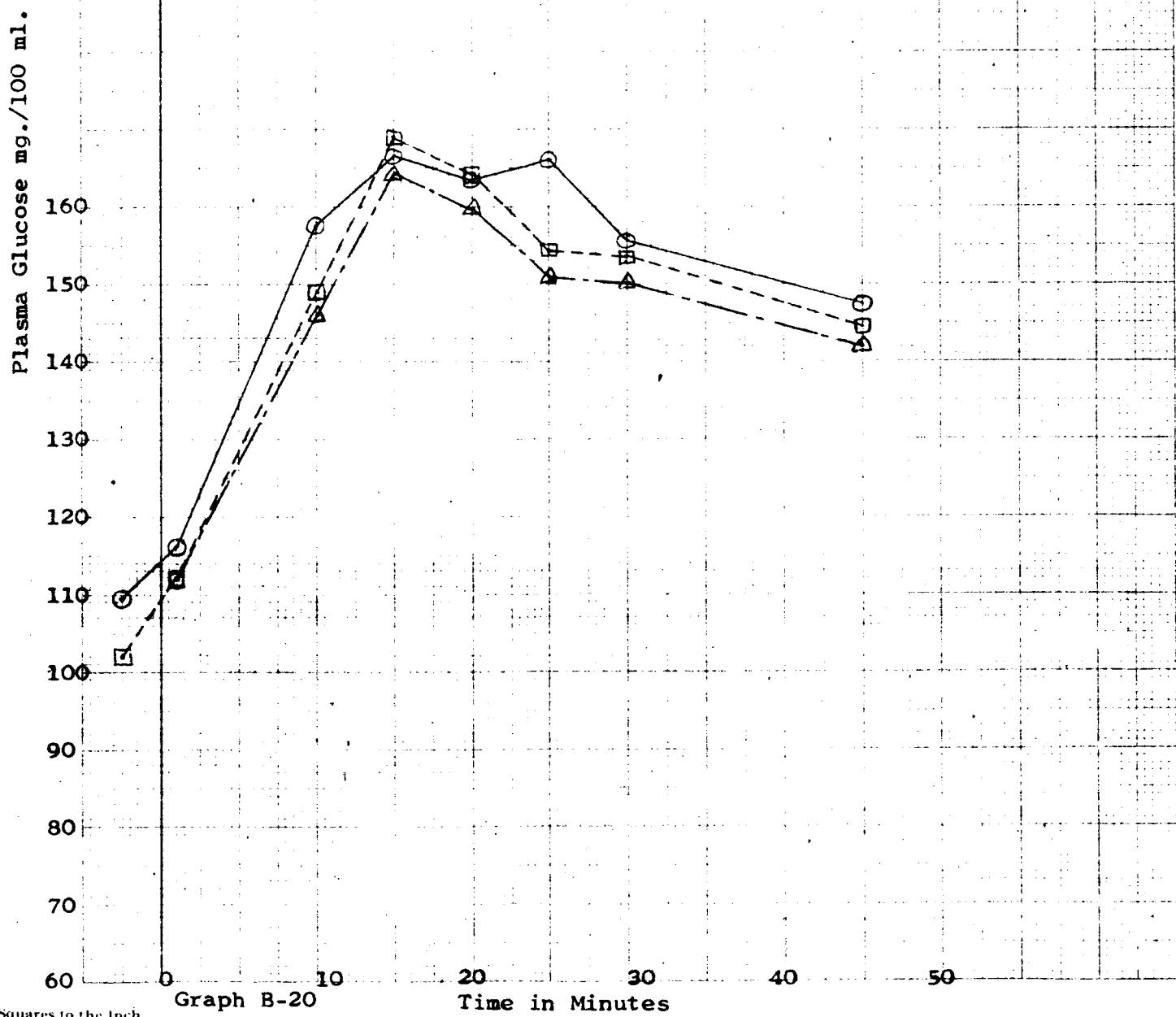
Graph B-19

Time in Minutes

GLUCOSE ABSORPTION CURVE (Week Twentieth)

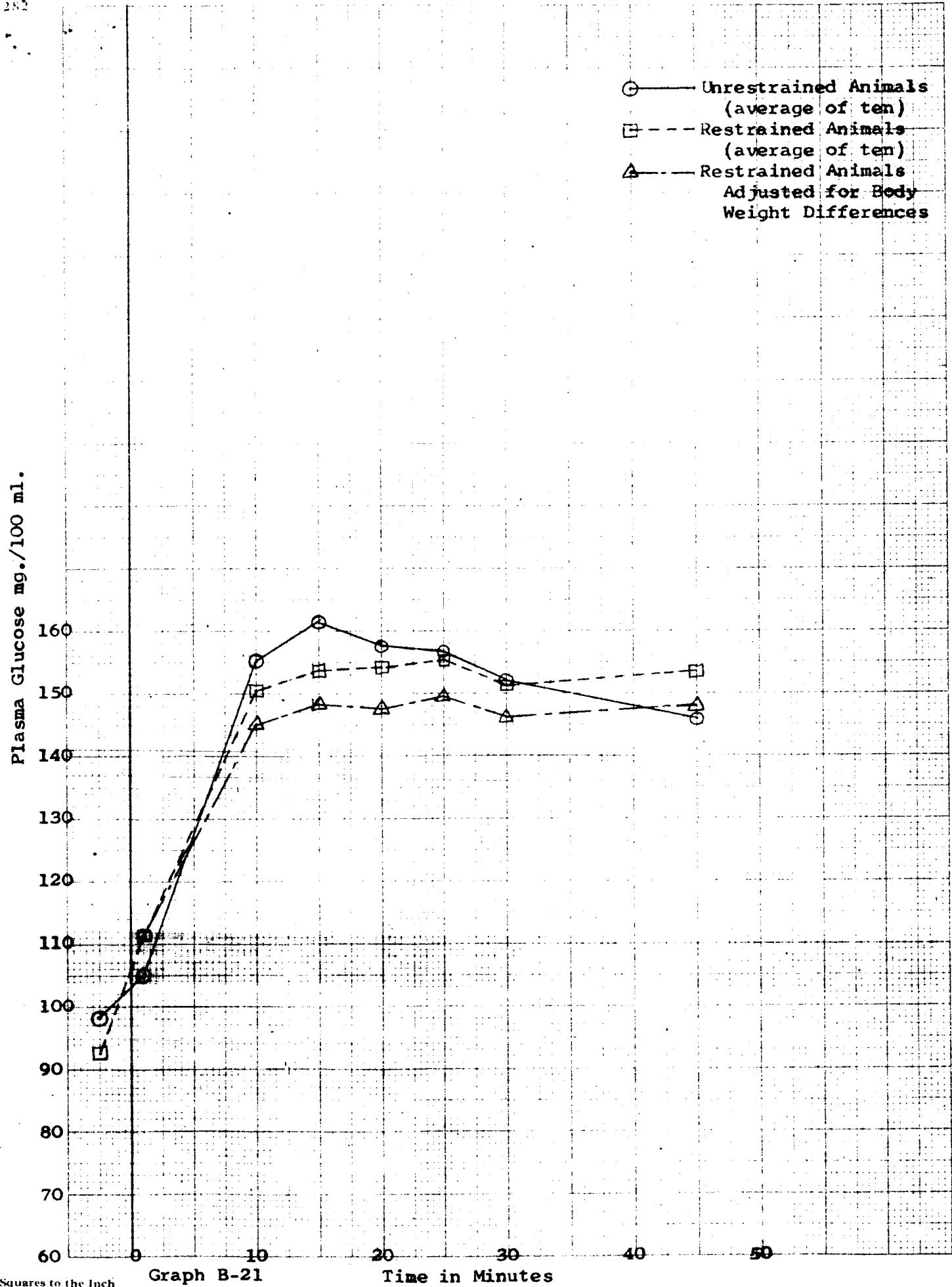
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- Unrestrained Animals
(average of ten)
- Restrained Animals
(average of ten)
- ▲— Restrained Animals
Adjusted for Body
Weight Differences



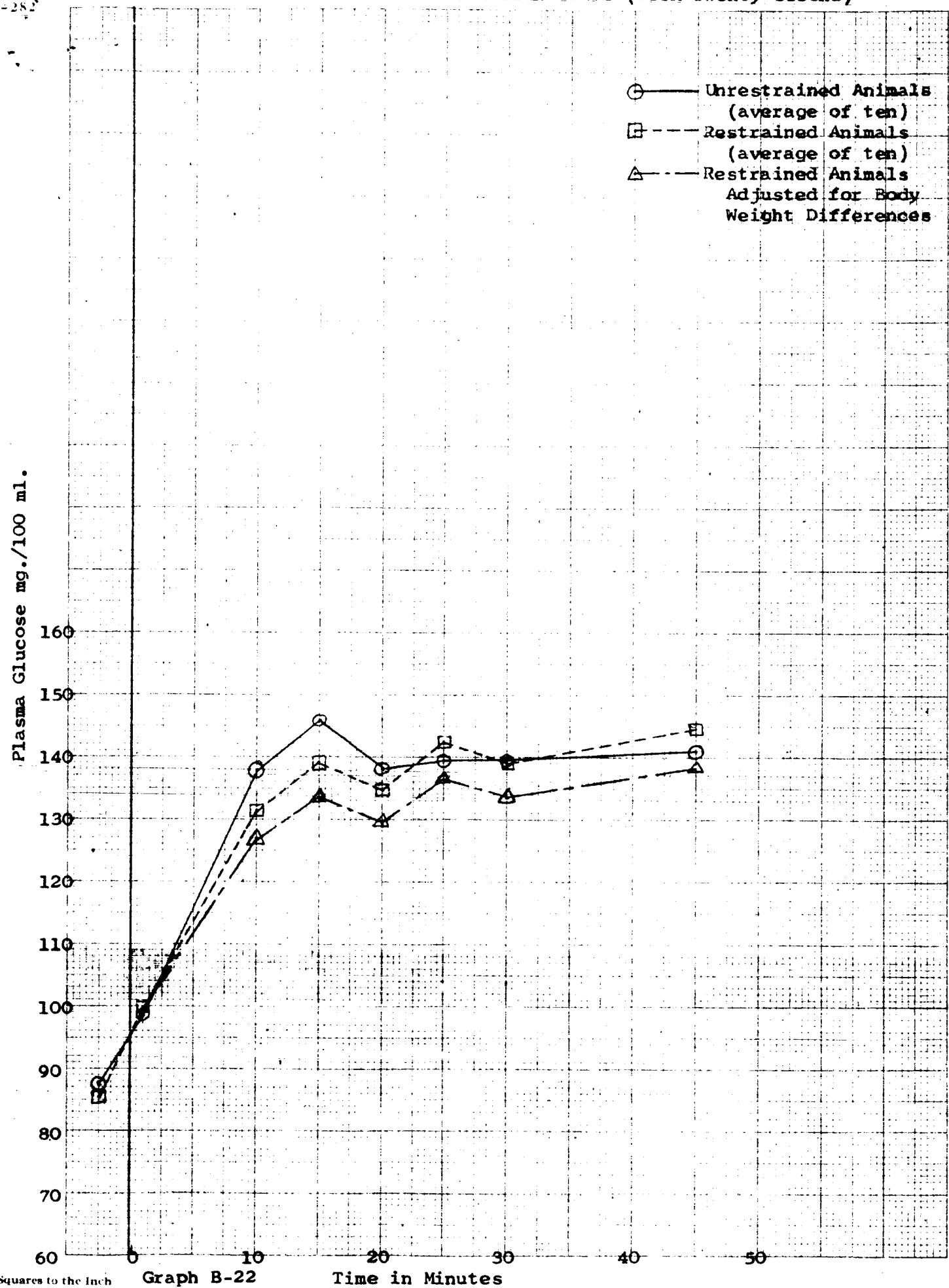
GLUCOSE ABSORPTION CURVE (Week Twenty-First)

12-282



GLUCOSE ABSORPTION CURVE (Week Twenty-Second)

12-282



20 Squares to the Inch

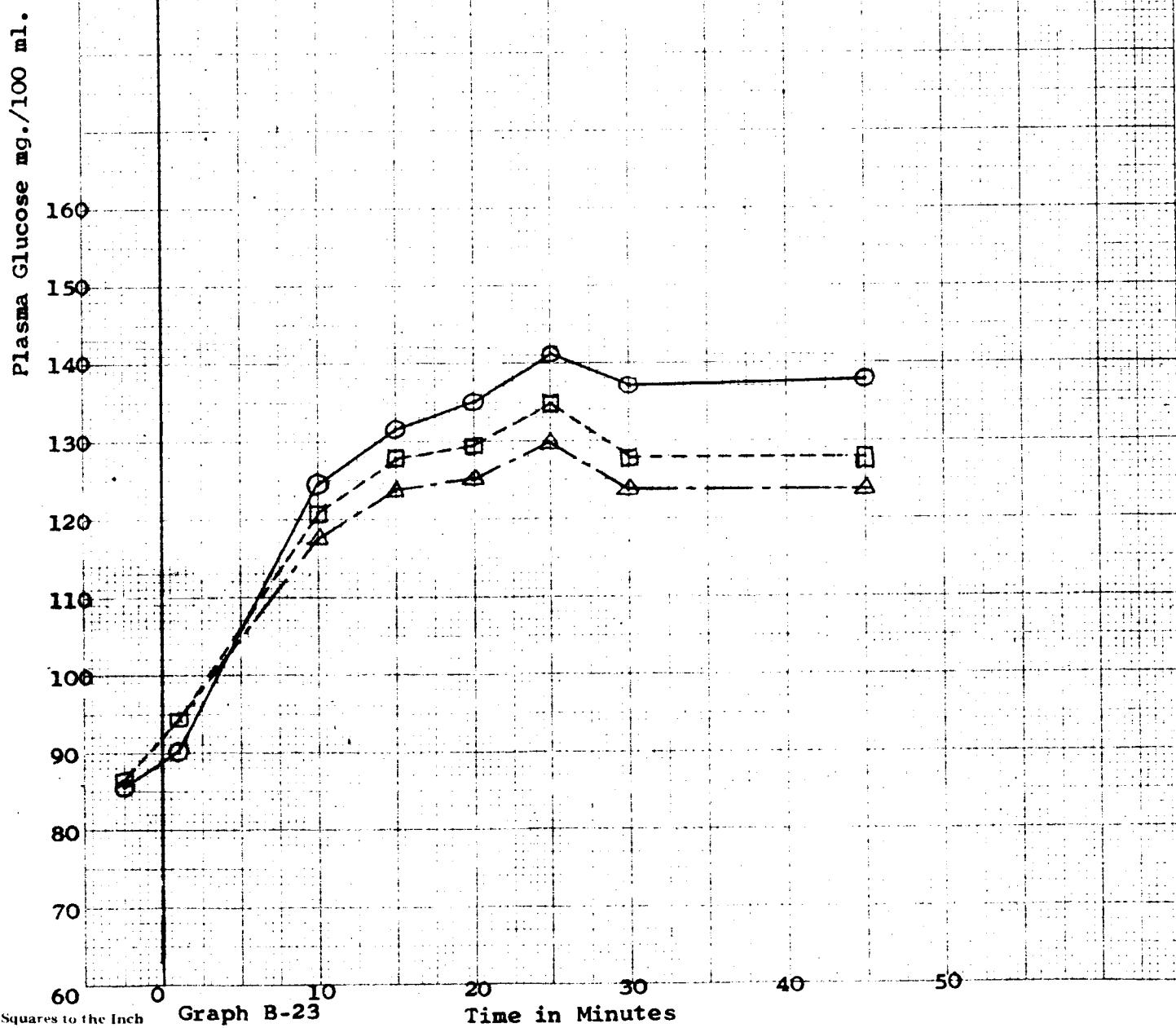
Graph B-22

Time in Minutes

GLUCOSE ABSORPTION CURVE (Week Twenty-Third)

12-282

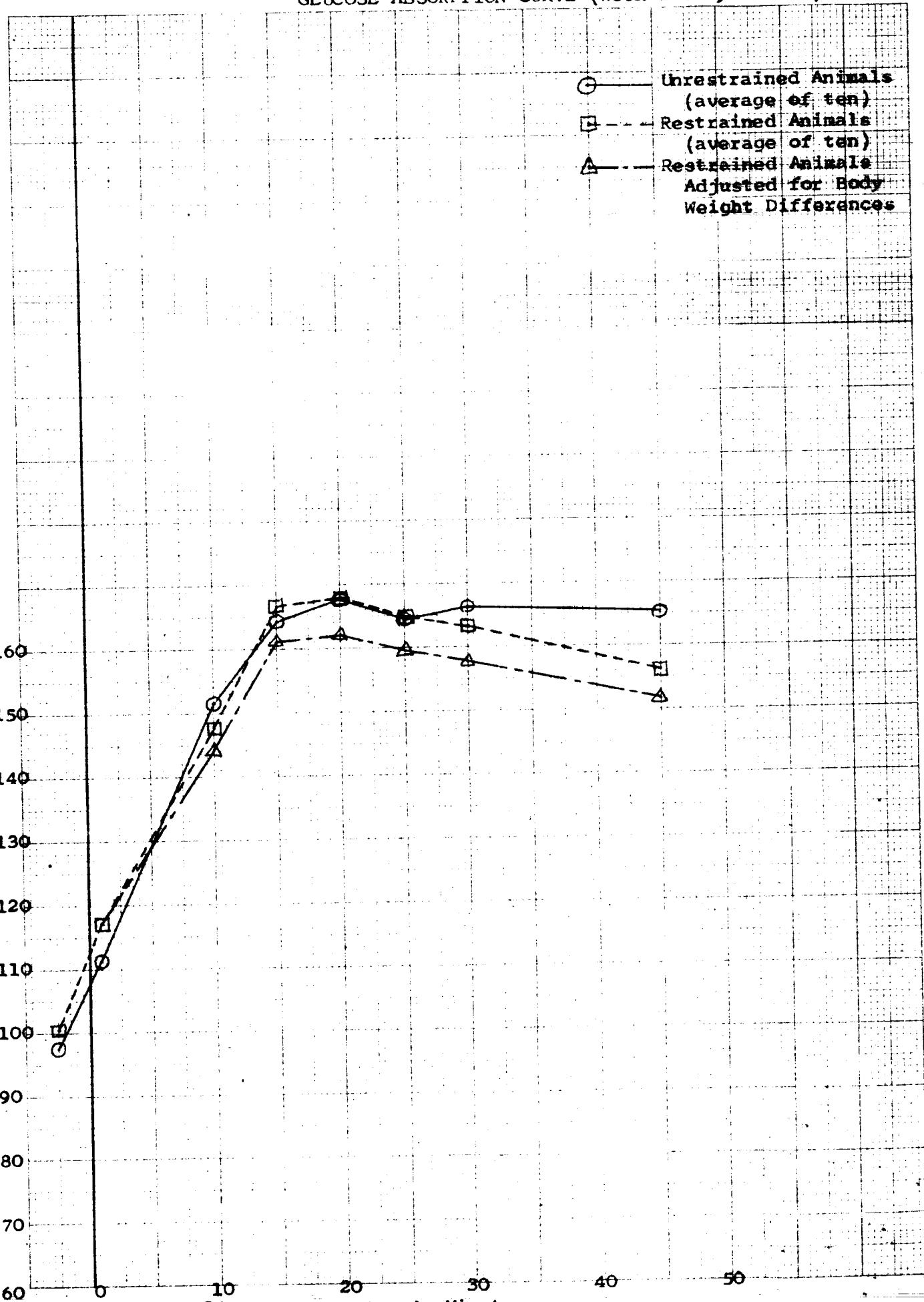
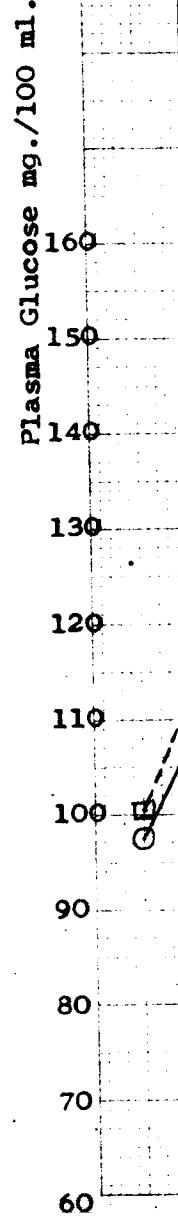
- - Unrestrained Animals (average of ten)
- - Restrained Animals (average of ten)
- △ - Restrained Animals Adjusted for Body Weight Differences



GLUCOSE ABSORPTION CURVE (Week Twenty-fourth)

12-282

- Unrestrained Animals
(average of ten)
- - - - Restrained Animals
(average of ten)
- △ - - - Restrained Animals
Adjusted for Body
Weight Differences

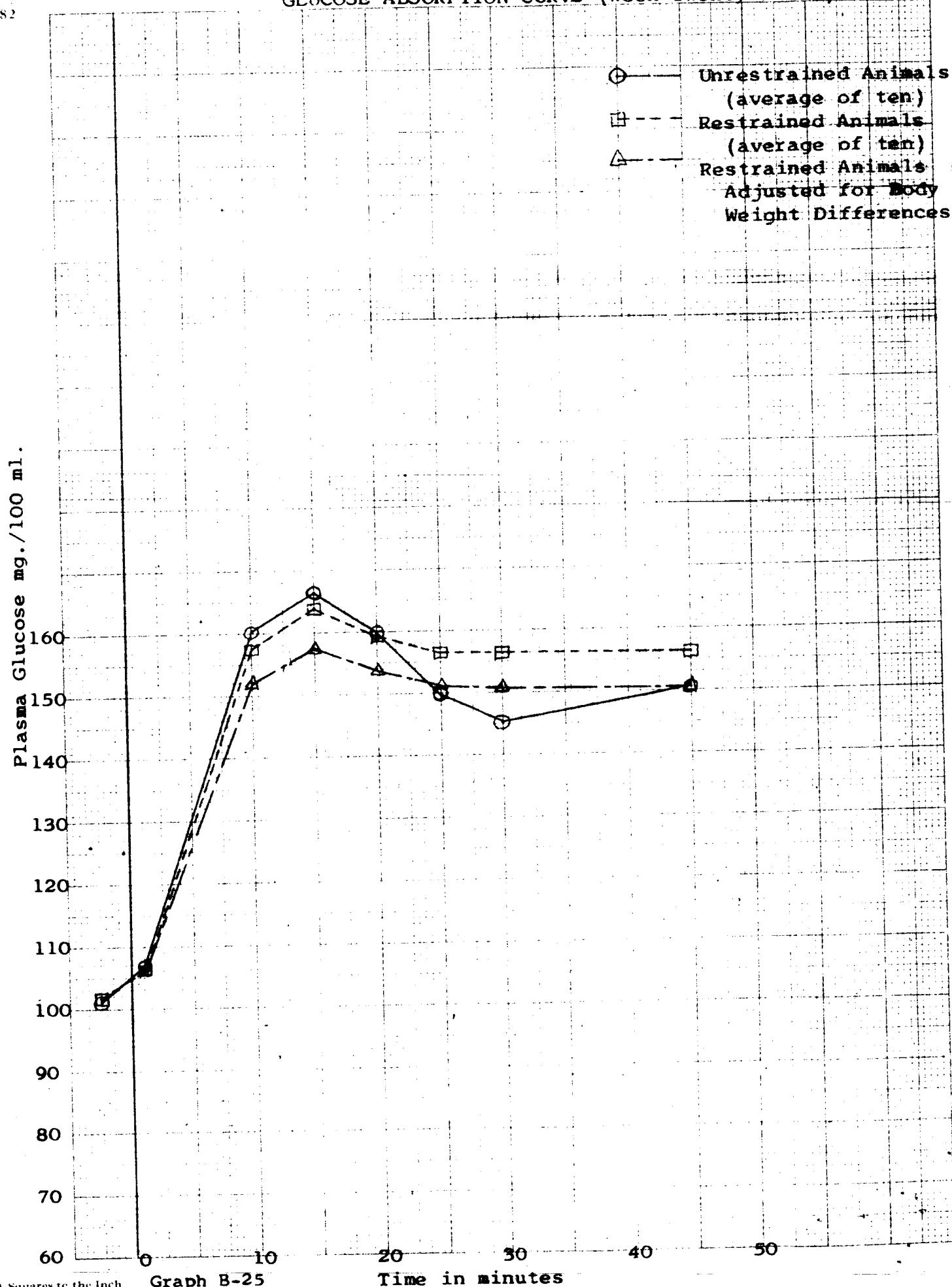


Graph B-24

Time in Minutes

GLUCOSE ABSORPTION CURVE (Week Twenty-Fifth)

12-282



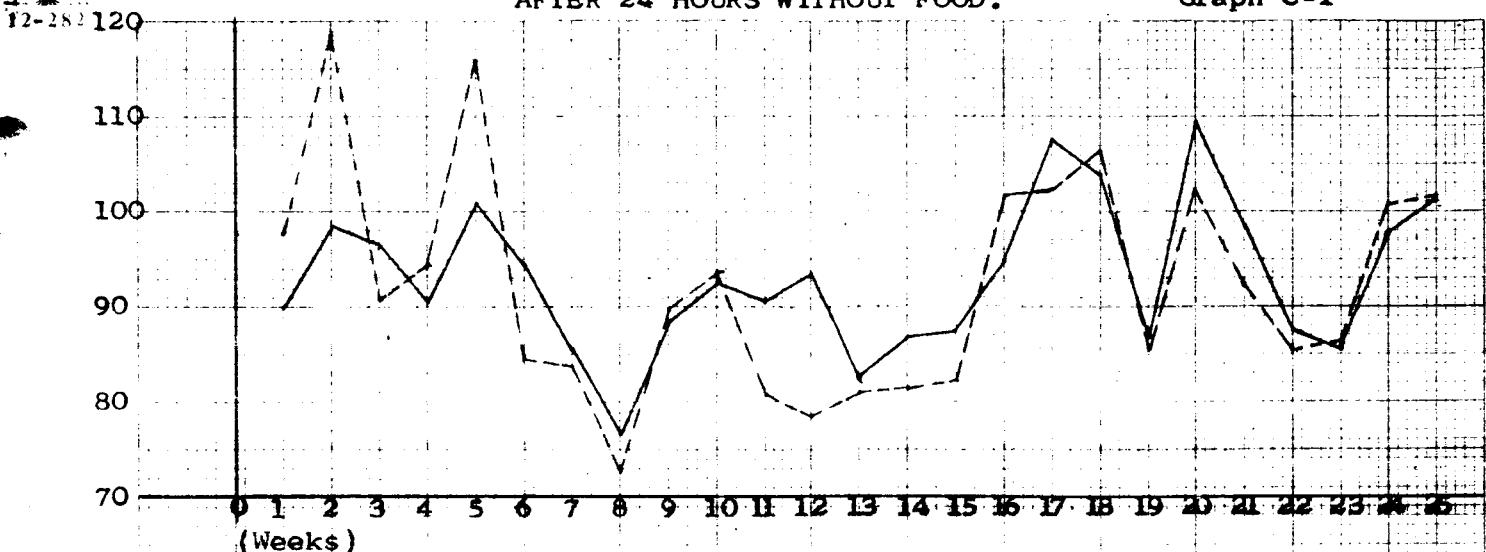
20 Squares to the Inch

Graph B-25

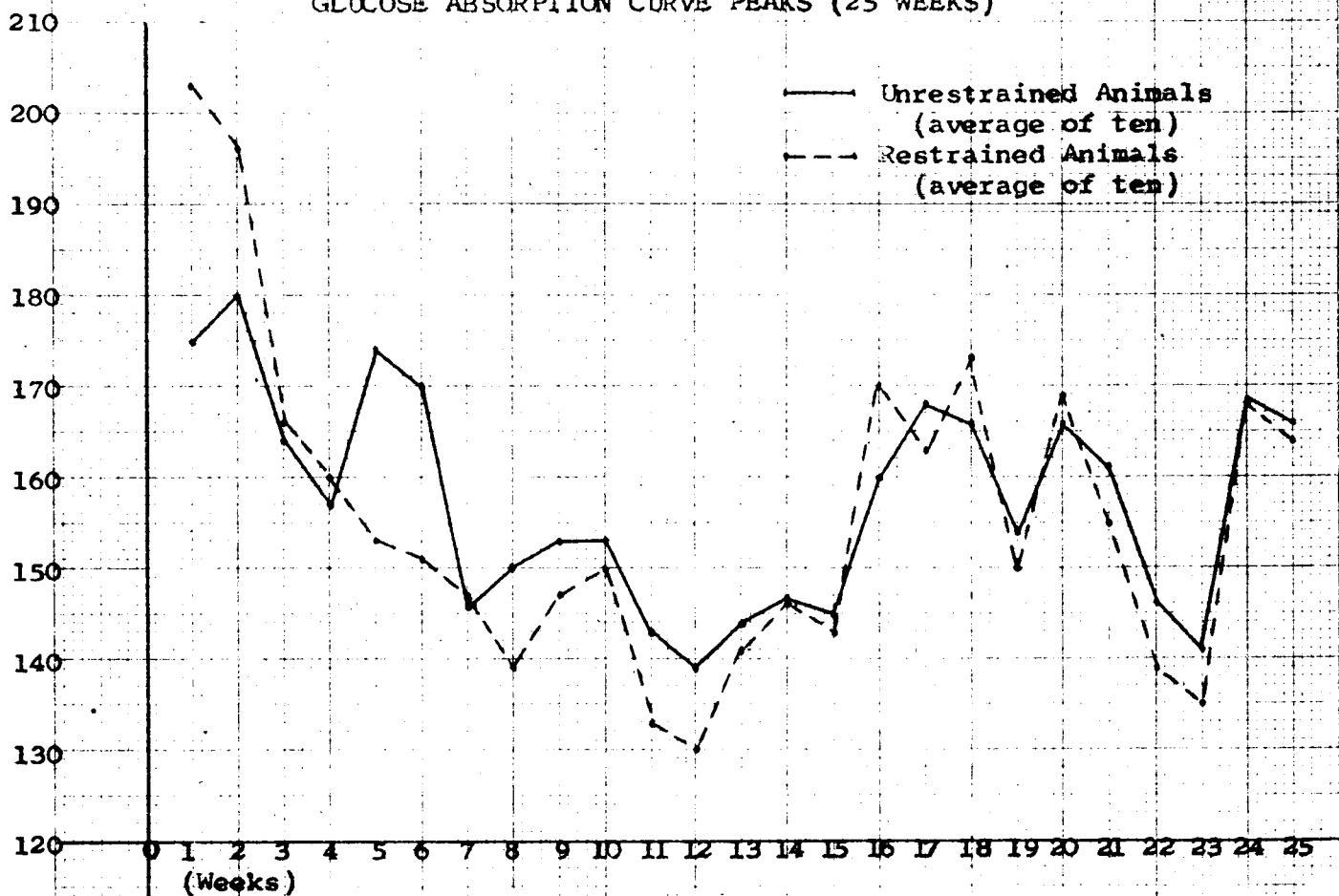
Time in minutes

PLASMA GLUCOSE mg./100 ml.
AFTER 24 HOURS WITHOUT FOOD.

Graph C-1

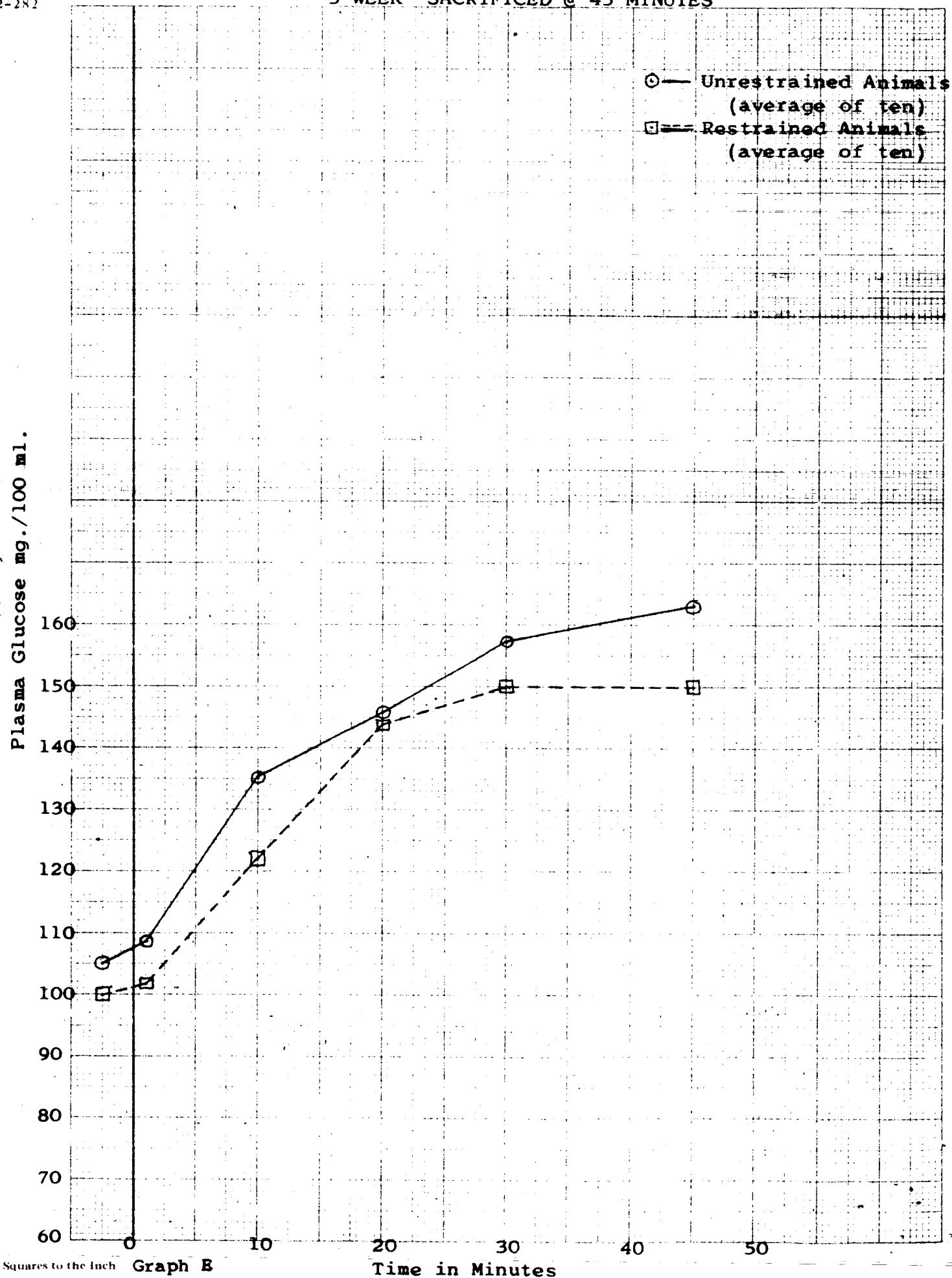


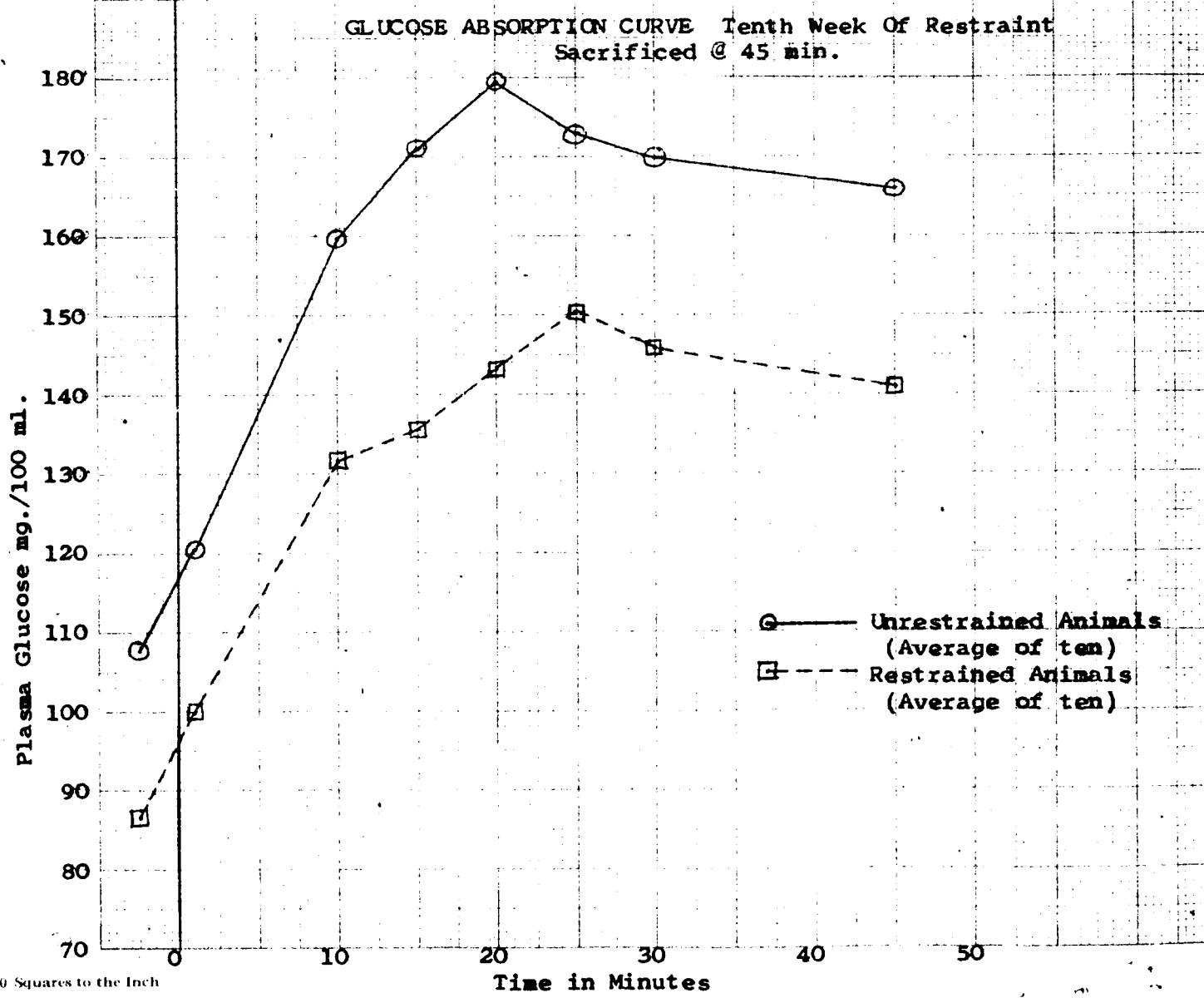
GLUCOSE ABSORPTION CURVE PEAKS (25 WEEKS)

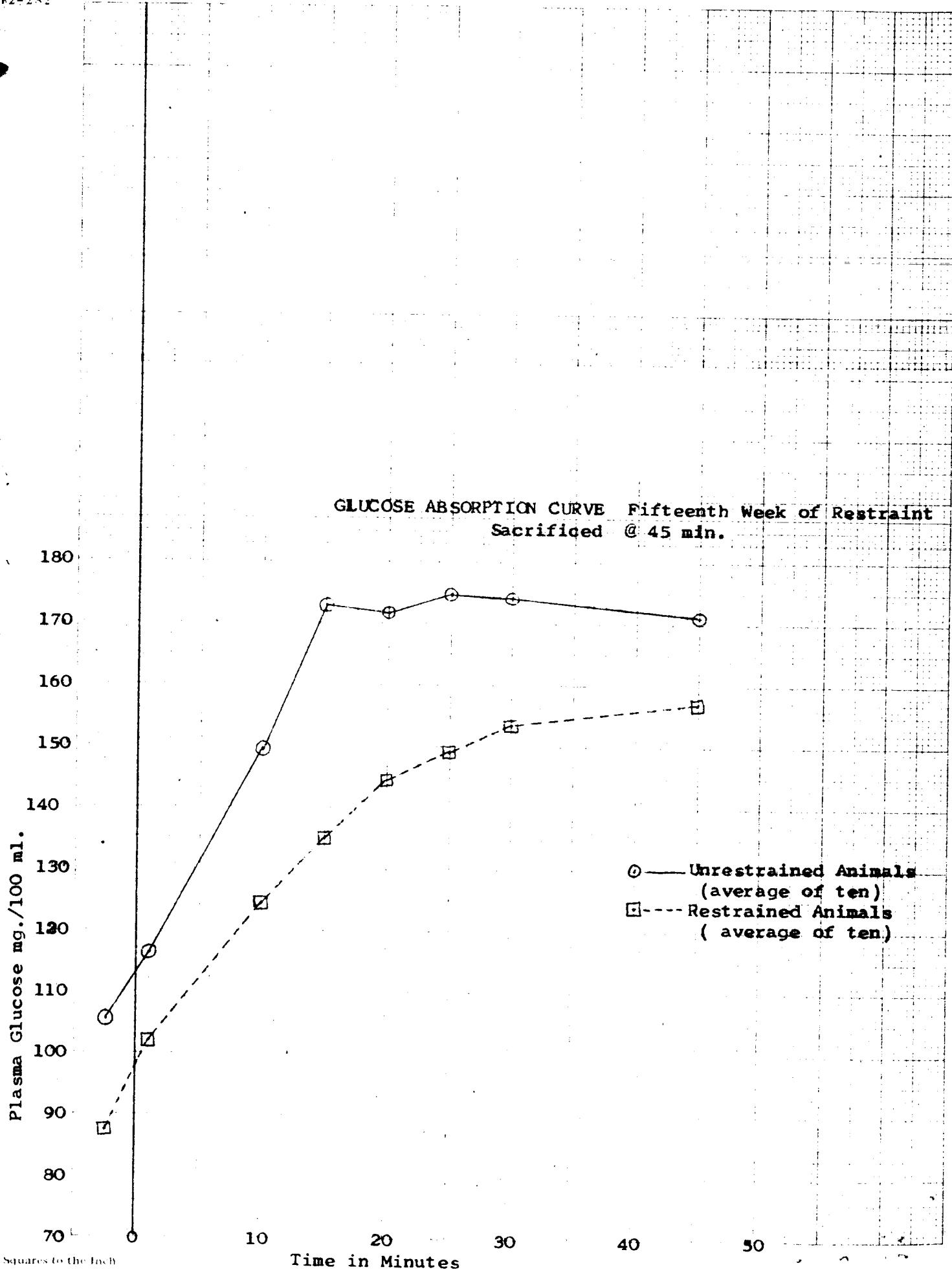


Graph C-2

5 WEEK SACRIFICED @ 45 MINUTES







MG. OF GLUCOSE RECOVERED FROM G-I TRACT AT END OF 45 MINUTES

Chart 3

Unrestrained

Animals	Stomach	Intestine
C-26	57.6	16.1
C-27	89.7	8.5
C-28	67.7	9.3
C-29	128.7	13.5
C-30	101.6	23.7
	Ave. 89.1	Ave. 14.2

Restrained

Animals

R-26	70.3	75.3
R-27	101.6	4.2
R-28	23.7	1.7
R-29	126.1	0
R-30	57.6	17.8
	Ave. 75.9	Ave. 19.8

GLUCOSE ABSORPTION CURVE (week Twentieth)

